Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

INDEX FOR VOLUME XXV, 1911

Illustrated Articles marked *.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXV. 114 Liberty Street, New York, January, 1912. No. 1

On the Silk Train.

The clipping of a few minutes from the record of a transatlantic trip is usually hailed as an event of world-wide importance, and little note is taken whether the new record is sustained by similar records in succeeding trips. On the other hand, when a new record involving a gain of almost an entire day in a transcontinental trip is made, and sustained day after day, it is somehow looked upon as a matter of course, and the world little notes the new and important triumph in land transportation.

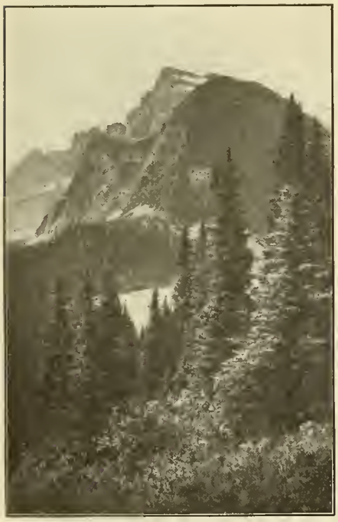
The most remarkable advance of this kind in many years occurred last October when the "Silk Train," starting over the Great Northern Railway at Seattle, Wash., ran to St. Paul, Minn., a distance of 1,814 miles, in 45 hours and 16 minutes and continuing the journey by the Burlington & Quincy Railway, with an increasing speed, making the distance of 431 miles in 9 hours and 44 minutes, and continuing by the Lake Shore & Michigan Southern Railway completed the journey to New York, making the entire distance from the Pacific to the Atlantic, or, more properly speaking, from Seattle to New York, a distance of 3,224 miles, in 81 hours and 50 minutes. The best previous record was 97 hours and 40 minutes so that the actual gain made was 16 hours and 10 minutes.

The average running of 40 miles an hour, including every kind of stoppage and delay, may not seem remarkable, in view of the higher speeds made on short, level runs, but to those familiar with the mountain ranges of Washington, Idaho and Montana, where several altitudes of nearly two miles have to be attained, some idea of the gigantic task may be readily imagined. The principal delays, however, did not occur in the widely circuitous windings

THE SILK TRAIN, GREAT NORTHERN RAILWAY.

among the mountains, but in the cities, particularly in St. Paul and Chicago, which together occasioned delays of nearly 3 hours.

It is also worthy of note that the equipment is unsurpassed in the elegance of the accommodation for passenger transportation, and not to be behind other American institutions in high-sounding titles the special train is now known as "The Million Dollar Silk Train," and is earning golden opinions from the traveling public. The locomotive in the illustration, as will be noted, is a Baldwin Pacific, equipped with the Walschaerts valve gear. These powerful locomotives are admirably suited for the heavy climbing work encountered in the Rockies, while in point of speed some of the level flats of Mon-



GOULD MOUNTAIN, AS SEEN FROM GRINNELL MOUNTAIN.

tana and North Dakota are traversed at a velocity that equals anything accomplished anywhere in the world.

Apart from the rapidity and comfort with which the journey from coast to coast may now be made on the Silk Train, the scenic wonders, especially in the West, are of a kind that never fail to strike even the most indifferent beholder with amazement. From Mount Rainier National Park, in Washington, to the Glacier National Park, in Montana, there is a world of picturesque grandeur and bewildering beauty that can be seen nowhere except in America. While the gorgeous coloring of the fall season adds to the richness of the scene, it is at all times a wonderland, and it is a matter of surprise to many that thousands of Americans flock yearly to the comparatively

LOOKING SOUTH FROM SUMMIT OF CASTLE MOUNTAIN.

tame and domestic scenes of European countries, and never think of seeing the grander wonders of our own magnificent mountain lands that lie within easy reach. It is gratifying, however, to learn that the marked improvement in railroad equipment, and the rapidity with which the intervening distances may be transversed is gradually awakening a wider and keener interest, and doubtless in the near future the tide of travel in search of the world's wonders will set Westward.

Of still greater importance, as we

LOOKING NORTH FROM SUMMIT OF FUSILLADE MOUNTAIN.

have frequently stated, is the rapid springing into existence of an endless chain of towns that are expanding into cities along the great arteries of traffic, and in this work the Great Northern Railway has opened up to civilization territories of incalculable wealth and enormous magnitude. With an actual roadway approaching 7,500 miles in length, and over 1,200 locomotives in operation, it already takes rank as one of the leading railways of the world, and with unlimited possibilities the future of this great railway cannot be other than one of rapidly increasing usefulness in the progress and development of the new and magnificent country through which it passes.

We cannot close this brief article without again alluding to the scenic

NORTH FORK OF BRIDGE CREEK, LAKE CHELAN, REGINA, WASH.

marvels of the Northwest. It is very much to the credit of the government that vast tracts of the most picturesque parts of the country have been preserved under conditions that guarantee a perpetuity of the grandeur and variety of scenes so majestic in outline, and clothed in such a profusion of the richest of coloring. In summer the wonderful panorama, from the spectral whiteness of the dim dawn to the red glory of sunset, is a moving kaleidoscope of nature in her brightest beauty and serenest solitude. We reproduce some sectional glimpses of photographs copyrighted by the Kiser Company of Portland, Ore., and kindly furnished by Mr. H. A. Noble, the gentlemanly general passenger agent of the Great Northern Railway.

In the Frozen North.

On the Rock Island Railroad near Colorado Springs, Colorado, there has blossomed into existence another of those reservations or parks which are destined to be the haunt of tourists. Colorado Springs is already a Mecca for those who have means and leisure and inclination to contemplate the marvelous in scenery. Pike's Peak and

ROADWAY, CRYSTAL PARK, COLORADO.

the Garden of the Gods are wonders enough, but the Crystal Park bids fair to become a successful rival to these wonderlands. It is not necessary to describe the elegance of the Rock Island express trains. They are the acme of perfection. On arriving at Manitou or Colorado Springs the visitor to the Crystal Park finds in waiting a line of high-class automobiles. The road winds around the mountain side for a distance of eight miles to an elevation 1,500 feet above Manitou. The view along the winding mountain road in the shadow of giant cliffs beside yawning chasms unfolds a constant panorama of wondrous beauty and scenic grandeur.

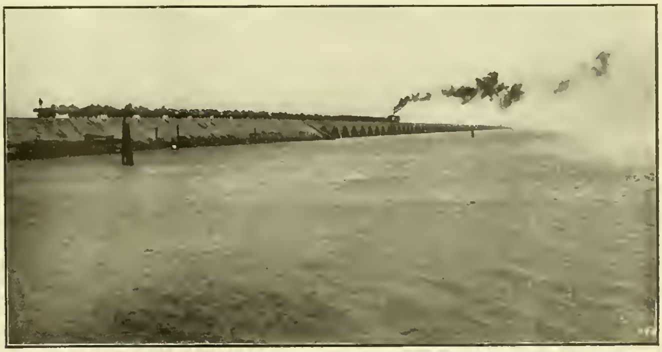
The construction of the road has been pronounced by engineers as one of the unusual feats of roadway construction work. In two instances switchbacks or wyes are built, and in one instance a turntable upon which the automobile is driven and the car turned around in order that the ascension of the mountain may be continued. The photograph reproduced in this page was taken in front of the turntable and shows the road over which the machine has come and is about to go. At the time when the photograph was taken there was six inches of snow on the ground, and, strange as it may seem, many tourists prefer to take the journey at this season of the year. The scenes are said to be of such a kind that the ice palaces of St. Petersburg or the crystal wonders of Niagara Falls in midwinter are nothing in comparison. Grotto after grotto of white wonder work defies the sunbeams. Personally, we would prefer the trip in the glow and glory of summer, or when the mountains are rainbow-hued in the early fall, but many claim that winter is the time to see the Crystal Park at its best, when it is in its white and shining beauty.

In the Sunny South.

Perhaps the most remarkable piece of railroad construction work in the South is the Long Key Viaduct at the extreme end of the Florida peninsula. It is a continuation of the Florida & East Coast Railway, and after leaving the Everglades it seems to continue its course across the Straits of Florida until it nearly reaches Havana in Cuba. It owes its existence to what are known as the Florida Keys, a series of coral reefs that extend southward and westward from the southern extremity of Florida to a distance of nearly 100 miles, and at all seasons of the year forms one of the most delightful trips imaginable, combining as it does the elegance and comfort of land travel with the sea air, in the seemingly everlasting balmy breath of June. As an engineering work it is without a parallel in the world. Such work, in fact, would be a physical impossibility in other than shallow and unruffled water. The coral reefs rise here and there and form the base of innumerable piers. In some instances the luxuriant flower-covered vegetation has already covered the piers as with a starry broidered mantle.

At this season of the year the equipment is taxed to the limit of its capacity, and the locomotives, of which there are nearly 100, are doing double service. The principal repair shops are located at St. Augustine, where Mr. G. A. Miller, the Superintendent of Motive Power, has his offices, and Mr. C. D. Vanaman, the Road Foreman of Engines, also has his headquarters. In the summer months, when the passenger traffic is not so heavy, the locomotives are thoroughly overhauled and made ready for the busy season, which extends from October till May, and it is particularly gratifying to learn that the management is so perfect in its mastery of details that scarcely a single accident has occurred. It can be readily imagined that a disaster occurring on an elevated road traversing what is literally the open sea would be serious in its results, and the management controls the situation with skill that is beyond praise.

Mr. J. D. Rahner, the genial and popular passenger agent, has issued a series of elegant descriptive pamphlets illustrative of this wonderland, and to those who feel the rigor of our Northern winter we cannot imagine anything to be compared to a trip to this delightful region. They should secure copies of the booklets, and then secure passage to the land of flowers, where the sunny days are a green and golden delight and when the nights are robed in still and starry splendor.



LONG KEY VIADUCT, FLORIDA & EAST COAST RAILWAY.

"Hello Bill—What Do You Know?"

W. E. Wood, Chicago.

A seemingly rude but common salutation between chums has furnished the topic for more than one telling speech.

Concealed information is useless. The tendency among business men of the past has been to be secretive and only profit by the brains of one organization.

Modern business men work along fraternal lines, freely giving to others valuable points from their own experience and receiving in return a broader knowledge than any one organization could impart.

The thought naturally follows that a professional man by giving a few leaves from his note book should also make suggestions to a works manager, which would at least contribute to cost reduction and increased efficiency, and that in a direction too frequently overlooked, namely, the building itself.

As an illustration, take a simple application of a well-known rule, suppose a building is desired to contain 40,000 sq. ft. of floor; if planned 400 ft. x 100 ft. it will require 1,000 lineal feet of wall; if planned 200 ft. x 200 ft. it will require but 800 ft. of wall. Again if the figures in the wall be doubled it will furnish four times the area—that is one reason why a large building is cheaper per square foot than a small building of similar character, and is also the reason why a square building is cheaper than one extended in length. The multi-story building has one obvious advantage in cost, the roof and excavation cost no more for five stories than for one. Its disadvantage as a manufacturing proposition is usually considered except where ground is very valuable.

Another point that is often overlooked may be found in a craneway support where it is not uncommon to carry a craneway on brackets riveted to a steel column; this places a severe bending moment upon the column, and the excessive size of the column is carried through to the roof. The better way is to make up a column of separate members carrying the craneway on one short member in a plumb line to the foundation, the other member of the column to be of proper strength to carry the roof and building structure, the long and short members being riveted together. Actual tests have shown 50 per cent. of the steel eliminated without any sacrifice in strength.

The type of construction that all are interested in today, namely, reinforced concrete, may also be utilized in many ways; one point that is, perhaps, overlooked more frequently than any other may be illustrated as follows: Suppose the column spacing selected be 16 ft. centers, the girders would carry floor slabs 16 ft. x 16 ft. If the girders instead of running square with the building, should be run diagonally from column to column, they would have floor slabs to support of about 11 ft. x 11 ft., thus reducing the thickness of the slab very materially. Then by carrying the reinforced girders on the cantilever plan, it would furnish a building with a series of groined arches adding very greatly to the appearance with economy in cost.

One of the most important features is, to plan for the future as well as the present, so that each step in construction shall become a part of a carefully planned whole. One leaf from the note book touches this point. A manufacturer wishes to build a warehouse, simple in construction and of a size absolutely determined by real estate. A visit to the shops discovered certain material brought in on a trolley at one end of the building where the work was being painted and piled to dry. At another part of the room the varnish was being applied and the work piled to dry. It was indicated to him that at some time he would probably extend the "I" beam, cutting a section to be supported by air cylinder so that the work might be dipped into a paint tank and moved along the trolley to dry, then dipped into the varnish, avoiding all hand labor. The plan seemed very attractive, and the question then arose, if that is to be done, why not extend the trolley into the warehouse, and if so, why not build the warehouse with ceilings at a proper level to receive the beam and with door opening at proper point. In other words it would cost no more to plan the warehouse to meet probable future conditions.

SNAP SHOT OF THE EMPIRE STATE EXPRESS, TAKEN AT 70 MILES AN HOUR.

For many years the effort for plant betterment seemed to be to avoid the foundry, where mysterious methods have prevailed and results were produced by facture and instinct.

Gradually the foundry is receiving the recognition to which it is entitled and more modern methods are now prevailing.

The foundry building should not be planned to the dimension of some particular piece of ground, but rather to the space required for proper and effective size mould floors with correct space for aisle and trolley or tram service, which dimension will furnish the key to the width of the building. If the roof is high and air circulation free, light tile roofing may be considered. Otherwise it should be avoided on account of condensation with consequent dripping into the moulds. Ample light and ventilation should be provided, as well as economical methods for quickly delivering metal and materials to mould floors and for advantageously removing the finished castings and handling the scrap.

One foundry "kink" that is attracting attention is a reinforced concrete support for holding the cope on edge and separating sand piles between moulding machines or skid moulders; it is cheap and permanent.

In planning a factory or any manufacturing building where trolley service is to be installed it is a waste of money to build the roof strong enough to carry the trolley load at every point when it will only be used at certain known points.

A factory turning out heavy mould work, of course, requires crane service with ample height, and in this type of foundry the auxiliary post jibs will do very effective work, more particularly when necessary to suspend copes for considerable time, the main cranes being free for other service.

The foundry running on light work and catering to a trade demanding small castings may have thousands of dollars worth of patterns belonging to customers, and if stored in fireproof pattern storage with all patterns carefully indexed, it is sure to attract the attention of the customer and give him such confidence in the safety of his property that he will leave his patterns with that foundryman, together with his subsequent orders.

In selecting the type of construction for any manufacturing building the character of the soil and local conditions as to labor and material should receive careful consideration. The next point and the vital one is that competitive bids should be taken on an accurate and open specification, which should not be drawn by anyone who is interested in the sale of material. It will save money in building costs as well as in the buying of any commodity. Any specified patented system eliminates competition. It is obviously no competition to receive several bids, which are based upon different designs and possibly figured upon different load factors.

In the matter of building layout and structural design, as well as in correct shop practice, the day of guess work is past; it is a field for careful, practical, technical study, and the subject is one that should receive full deliberation.

There is a right way and a wrong way to pile cord wood.

General Correspondence

Great Improvements on the Chicago & Northwestern Shops at Boone, Ia.

Editor:

You will be pleased to learn that the extensive improvements on the machine shops and roundhouse here are completed and almost in full operation. The engineers of the Chicago & Northwestern are certainly to be congratulated on the excellent plans which have transformed our limited accommodations to one of the largest and best equipped divisions in the West. The new section of the engine house is 90 ft. deep, built of concrete and brick, and consists of 36 stalls instead of 24, as formerly, with every modern improvement in steam, air and water piping. The heating apparatus is much appreciated by the engine house men. It consists of drawing air by a powerful fan through steam radiators and forcing the heated air through concrete tunnels to all parts of the house. The heater plant is housed in a concrete and brick building, 40 ft. by 46 ft., with provision for duplicate installation in the future. It was furnished by the Green Fuel Economizer Company. A boiler washing plant is located in another concrete and brick building. 32 ft. x 35 ft. immediately adjoining the roundhouse. Hot water is supplied to all parts of the engine house for washing out locomotives.

The new machine shop is 164 ft. x 293 ft., and is also thoroughly modern in every particular. The foundations are of concrete, with brick walls carrying steel trusses for supporting the roof. The roof is of the saw-tooth type, with ample provision for light through steel sash windows. In one-half of the building there are twelve tracks for use in locomotive repair work. Access to the house is by means of a track coming in from the east side and running the full length of the house. Another track also enters from the northeast corner.

A concrete pipe tunnel runs the whole length of the house, 5 ft. x 7 ft., and carries all steam, water and air piping. A fire hose apparatus is also in ready operation. The north half of the building comprises the boiler shop, machine and carpenter shops, all completed with a full equipment of the very best modern machinery. A 30-ton crane traverses the entire space over the 12 engine stalls, while along the center of the building there is a 5-ton crane traversing the entire space from end to end of the shop. The 30-ton crane has a span of 67 ft.

The transfer table is operated by electricity, and is capable of carrying the heaviest locomotives. A cable operated by the machinery in the transfer table draws the locomotives into any part of the house. The transfer table operates in a pit 400 ft. long.

The power house is also a very substantial building of concrete, brick and steel located east of the roundhouse. It is 54 ft. x 154 ft., and is divided into two rooms—one for engines, motors and compressors, and one for boilers. There are 6 boilers of 150 horsepower each, with foundations ready for two more when required. The boilers are all connected to the stack by sheet iron connections 5 ft. x 7 ft. The steam pipe from each boiler is connected to a heavy pipe header, which is carried down into the pipe conduit and distributed to the engine house, machine shop, heater room and washout room.

The smokestack is 7 ft. in diameter and 125 ft. in height. It rests on a concrete foundation 22 ft. square at the base and 8 ft. deep. The store house and oil room are separate buildings, the former is 32 ft. x 100 ft. and the latter 26 ft. x 34 ft. There are also two water tanks. These are 50 ft. high, and each has a capacity of 150,000 gallons, and in addition to these there are two wooden tanks of 50,000 gallons each. A complete sanding plant and ice house complete the new buildings.

NEW REPAIR SHOPS OF THE CHICAGO & NORTHWESTERN AT BOONE, IOWA.

The extensive yards have practically been reconstructed, involving 16 miles of new track, with 50 new switches. Mr. J. W. Towne, engineer of maintenance, Chicago, has had entire charge of the construction work, and has been ably assisted by Mr. H. Rettinghouse, division engineer at Boone.

It need hardly be added that the entire mechanical department greatly appreciate the improved conditions under which we are now working. Formerly the winter was a serious time with us. We can now defy the elements.

A. B. Silliman.

Boone, Iowa.

Tool Holder Used on Rod Grease Cups.

Editor:

The enclosed are sketches of a tool holder for three tools used in turning, nicking and cutting thread on rod grease cups.

These cups are of the standard type, screwing into rod and plug screwing into clip to force grease on to pin. These cups are bored and tapped out on inside in a turret lathe. They are then screwed onto a nose chuck in a small engine lathe, to be finished on end screwing into rod.

After the cup is screwed on to the nose chuck they are finished by the combination tool.

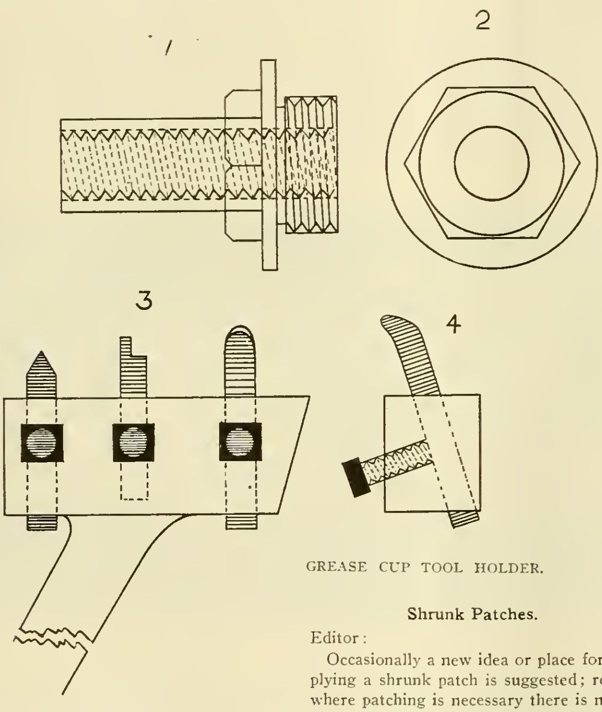
Fig. 1 is side view of cup, showing the internal threading where cup is screwed on nose chuck, also the threads on rod end cut by combination tool.

Fig. 2 shows end view of cup.

Fig. 3 shows combination tool ready for use with roughing tool, parting tool and threading tool.

Fig. 4 shows side view of holder, also showing the angle of tools in order to raise or lower tools aside from adjusting holder. The roughing tool is used first to take off stock and turn the diameter to size. Next the parting tool to give clearance for thread when threading. Then the cup is ready for threading; care being taken to have roughing tool extended further than parting tool and also parting tool extended further than threading tool so no other tool will come in contact with work than the one being used at the time. This combination tool saves the operator the time and trouble of changing three tools, as by the single or old-style method. This tool holder was designed by Mr. Sillinant, a lathe hand at our railway shops here.

John W. Percy,
South Tacoma, Wash.



GREASE CUP TOOL HOLDER.

Shrunk Patches.

Editor:

Occasionally a new idea or place for applying a shrunk patch is suggested; really where patching is necessary there is nothing better where it can be used than a well-fitted, sufficiently strong shrunk patch.

Cracked or broken frames, rocker arms, frame splices, broken jaws, cylinders, cylinder heads, steam chests, can be in a great many instances quickly and substantially repaired by a properly applied shrunk patch or clamp.

In one instance of a frame twisted outward causing driving boxes to run hot continually, a heavy tie brace was gotten out with a lug on each end, made ¼ inch short, drilled for bolts at each end, heated and shrunk on between the two frames, stopping the trouble altogether. X. Y. Z.

The Hobart-Allfree Valve Gear.

Editor:

Of the several outside gears for actuating the valves of modern locomotives the Hobart-Allfree gear is the most acceptable to the writer. While, in the language of the disciples of Blackstone, the writer holds no brief for the Hobart-Allfree Company, yet he would direct attention to the fact that a line drawn through the center of the axle and the point of connection of the eccentric rod in the element of the Hobart-Allfree gear, which, in the nomenclature adopted by the Hobart-Allfree Company, is called the transmission bar, is nearly but not quite horizontal, which makes the distributing effect, due to the vertical displacement of the main axle in the frame jaw less than when said line is much inclined. The writer has before him a record of valve events of engine No. 486, of the Kansas City Southern Railway, which is little short of absolute perfection, though this may be attributed to the use of the entire Hobart-Allfree system of steam distribution—that is, cylinders, valves and radial valve gear. In every instance where there is an inequality of cut-offs amounting to a small fraction of the piston stroke, the later cut-off occurs at the crank end of the cylinder. This is caused by the valve gear and is more desirable than otherwise. To one who has been particularly attentive to the many "Radial" valve gears, it would seem that "The Grand Kinematician" had plotted the paths of the pivot points of kinematic chains which even our prolific inventors must travel over, since in all of the "Radial" valve gears one of the pivots is constrained to cross the central line of motion by either a swinging link or a curved guide, and the center from which the guiding link swings or from which the arc of the curved guide is struck, is controlled by the reverse lever and the engineer in reversing the engine and in altering the travel of the valve.

Personally the writer is of the opinion that the Hobart-Allfree, Baker and Walschaert gears are more fool proof than the Stephenson shifting link motion, and herein will mention an occurrence as tending to strengthen such opinion.

A 4-6-0 passenger engine having flat valves, driven by the Stephenson link motion through reversing rockers, came out of the division back shop and was placed in service.

Owing to ill-timed exhaust reports and unsatisfactory performance, the engineer, upon arrival at the terminal round house, reported "valves out," and in due time a machinist who is as competent and reliable as one finds among good workmen, "ran over" the valves and found that on one side the cut-off occurred at 8½ ins. in the head end, and at 11 ins. in back

end of cylinder. Just here the writer desires to submit the opinion that had this machinist previously provided himself with Auchincloss' splendid book on "Link and Valve Motions" and a set of drawing instruments, and had laid out link motion suspended for equal cut-offs, for a later cut-off in the head end than in the crank end of the cylinder, and also for a later cut-off in the crank end than in the head end of the cylinder, he would have jumped down in the pit confidently expecting to find the link saddle on the lame side turned end for end. But he was not so equipped. The bolts which secured the eccentric rods to the eccentric straps were removed and the eccentric rods were lengthened, thereby destroying the correct timing of the lead openings. After all this had been done a very late discovery was made that the link saddle on the lame side of the engine "was not in style," considering the saddle on the good side as an exemplar. So the cause of the lame engine was removed and the "work done in the dark" was undone at the expense of much time and labor. This actually happened and is therefore not a fable, but has a moral just the same.

The moral is: "It Is Well to Have Knowledge of Dresden China Vases Even While at the Level of Ashpans."

HARRY CORNELL.

Louisville, Ky.

Qualifications of Shop Foreman.

Editor:

Having heard a good deal of discussion concerning the attributes that make a good shop foreman, I wish to place before your readers the views of a very successful superintendent of motive power upon the subject as published several years ago. The gentleman wrote:

"The selection should be made from the shop force, and from the class that are active, energetic, conservative and progressive, with moral character predominating, giving preference to the oldest man if merits are equal. In qualifications, fair knowledge of figures, reading and writing are essential; being able to comprehend orders quickly, read drawings, have executive ability and a turn for getting on well with both men and masters. These last two qualities are really the most important. The ability to impart information to others cannot be dispensed with. If a man prefers to do a job himself rather than go into the details of instructing others he is not fitted for performing the duties of a foreman. Knowing how work should be done and having the will and ability to direct others to do it describes the first-class foreman.

It is gratifying to observe that the kind of men that I have briefly described are rapidly increasing in number.

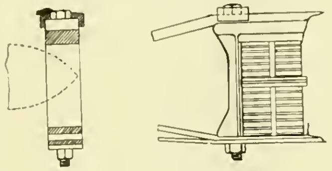
TIMEKEEPER.

Buffalo, N. Y.

Bolt Holder and Hose Holder.

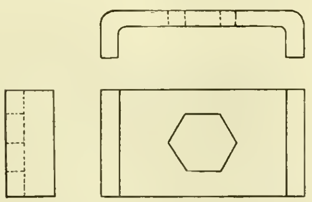
Editor:

Attached are two drawings showing two devices in use here. The first is adapted for holding bolts from turning while being tightened up. It is not uncommon that tender truck bolts will turn while the nuts are being tightened up, as



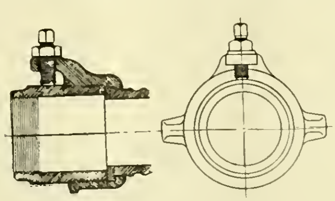
TENDER TRUCK BOLT HOLDER.

the bolts are not usually fitted as carefully as engine frame and other bolts are. As shown in the drawing, it is simply a piece of iron with a hole punched in the center and fitted so that it will readily slip over the head of the bolt, and the ends of the piece of iron are bent over to fit over the arch bar. It can be made, of



DETAILS OF BOLT HOLDER.

course, in various sizes, and is a labor-saving device either in assembling or dismantling tender or other trucks. The methods commonly in use of attaching wrenches to the heads of refractory bolts is neither conducive to good workmanship or good temper. An assistant is frequently called into service before the tug of war is ended, but with the holding de-



TENDER HOSE HOLDER.

vice described no such assistance is required.

In regard to the second drawing, it may be remarked that there are, no doubt, a large number of important failures caused by tender hose nuts unscrewing from the feed pipe connection, and not being observed until the tender is empty of water. A failure of this kind is a serious matter and may be entirely prevented by simply having a projecting lug cast on the hose nut. The lug may be readily drilled and tapped out to receive a set screw and jam nut, as shown in the drawing, and when the set screw is properly tightened up against the feed pipe sleeve, after the hose nut has been tightened, it will positively prevent the hose nut from loosening.

CHAS. MARKEL,
Shop Foreman.
C. & N. W. Railway, Clinton, Iowa.

Superheating.

Editor:

I observe in the November issue of RAILWAY AND LOCOMOTIVE ENGINEERING that Mr. F. P. Roesch and Mr. George H. Travis have both taken me to task in regard to my views on superheating. Mr. Roesch states that "the boiler end of the superheater tubes is in direct communication with the steam in the boiler, consequently if adding heat to the steam in the superheater tubes resulted in an increase in pressure, this pressure would naturally flow back through the open end of the tubes into the boiler, thereby raising the boiler pressure."

Mr. Roesch must have gotten his information about superheater construction from a very different source from where I got mine; what I got was, the open end, as he is pleased to term it, is not connected to the boiler, but to a header, which in turn is connected to the dry pipe, and the steam, from the supply in dry pipe and header, goes into the 1¼-in. superheater pipes on its course to the steam pipe and thence to steam chest; such being the fact, I should term the steam pipe end of the superheater pipe the open end, as it is the final end of the superheater, and when the first flow of steam after throttle has been opened reaches that end of superheater pipe, it finds nothing to hinder its egress, nor does it find anything but the piston in its farther flight from that burning heat, and in its determination to get to the true opening and be liberated, it just pushes the piston out of the way and goes on; this work alternates. It is a variable resistance, hence, it has an opportunity to flow in this direction, but back at the boiler end you have a constant pressure maintained in a pipe 6 or 8 ins. in diameter, which is supplying these 1¼-in. pipes, and steam, like water, will always go in the direction of least resistance and it could not flow back into the boiler. But what it can do, and what I believe it does do, is to retard the flow from boiler, because the volume taken from header into superheater pipes has been increased in volume and pressure when it gets to steam pipes, and as cylinders

can only take so much of it, it is, so to speak, halted in its journey. Is this logic? If it is not logic why does a superheater engine burn less coal, run farther for water and at the same time pull a heavier load at same rate of speed, or same load at a higher rate of speed?

In nature there are no accidents nor chances. Everything is in conformity with law and order. You do not get something for nothing. You might just as well tell me that you could, on an even balance, take an 8-oz. weight balancing an 8-oz. load on the other end, then pare off 1 oz. of the weight and add it to the load end, and still have a balance; 7-oz. weight balancing 9-oz. load, as to try to tell me that the increased efficiency of the superheater is produced in spite of decreased pressure.

The whole field of force is governed by that mysterious unknown, unchangeable fact which the various stages of ignorance and superstition, from fetishism to scientific research, try to account for in many and varying manners, but in all of them water runs down hill, weights seek lower levels, unsupported articles fall, the inexorable law is that a given force of resistance must be overbalanced by a greater force of energy before it yields its passive force; it never yields to a lesser force.

The passive force of resistance of the train of cars yield their identity to that force of steam energy acting on the piston's surface, and you can only make a greater resistance yield by the application of a greater energy. This is nature's law and it, not only like the law of the Medes and Persians, is irrevocable, but it cannot be countermanded, as all that finite man can do is utilize his mentality, and by right research in the realm of infinity bring to light facts which were and still are a part of that natural law.

It is admitted and, I believe, proved that a superheater engine size for size, pulls more weight at a higher rate of speed, burns less coal and uses less water than a saturated steam engine. Let us analyze this admitted fact.

Taking the usual practice of 2 ins. greater diameter cylinder for the superheater than for a corresponding saturated steam engine, but in some instances results were given on cylinders of same size. A 21-in. cylinder saturated steam engine carrying 210 lbs. steam has the same mechanical design of frame, wheels, truck, diameter and length of boiler, etc., and weighs the same as a 23-in. superheater engine carrying 165 lbs. of steam and intended to do the same work; the 21-in. cylinder engine presents for each application of energy 346 sq. ins. of surface, and if you say you get 80 per cent. pressure you would have $80 \times 168 = 57{,}128$ lbs. energy.

The superheater engine has 405 sq. ins. of piston surface for each alternating application of 80 per cent. of 165, which would be $80 \times 132 = 53{,}460$, a little over 7 per cent. greater for the saturated engine, and they claim the superheater loses some of its pressure going through superheater pipes, which would make it even less than the 53,460 which I figure; how in the realm of physical science can you figure that this less energy can accomplish that greater result.

This is not all, it is usually admitted that the higher steam pressure is the less water it contains, and now we come to the real anomaly of Mr. Roesch's and Mr. Curtis' contention, taking the size of cylinders given, 21-in. saturated and 23-in. superheater, I find again that my saturated steam engine presents 346 sq. ins. of surface to the higher pressure steam, while the superheater engine presents 405 sq. ins. of surface to the lower pressure steam, or to each stroke the saturated engine would use 346 volumes of steam, while the superheater engine would use, to each stroke, 405 volumes of steam, 17 per cent. more on each stroke and yet at the same time pull more load and make from 12 per cent. to 20 per cent. greater mileage for water, use 17 per cent. more and yet go 20 per cent. farther.

Mr. Roesch says, "I did not make an outdoor superheater, but simply added heat to the pipe, which prevented condensation." Well, what does the superheater do, the pipe goes through the superheater flue and back and into the next one and then to the steam pipe. The heat of the hot gases passing from fire box through the superheater flues simply heats the superheater pipe and its effect is produced on those flying, hurrying H_2O molecules just like my arrangement on the steam pipe, and, while I did not have the intensity of heat and could not produce the maximum result of the mechanical superheater, I affirm that I made an outdoor superheater and demonstrated it by the work done by the engine which drove the pump, but I will admit that I did not at that time know anything about superheat, but was just trying to utilize my mentality and succeeded.

Both of these gentlemen say it would be impossible to start steam at 212 degs. through pipes in a furnace and add heat and get the results at the other end in gauge pressure, which would be the result on a gauge registering pressure of steam generated by the absorption of heat by water direct. They merely make a flat assertion; they don't give anything in lieu of the hypothesis which they attempt to destroy.

I maintain that my statements are not fallacies, that like causes produce like results, that as heat added to water volatilizes it and makes it rebellious, having energy, which energy is increased with the increase of temperature, that the H_2O molecules retain their affinity, after volatilization for heat, and respond by increasing their rebelliousness, showing greater pressure and occupying more space, giving a greater number of volumes of steam for each volume of water. That is why the engine pulls more load and goes farther for water when superheater is used, as shown by those who have tested it.

A. J. Schmidt.

Shreveport, La.

MODEL OF AN AMERICAN LOCOMOTIVE, BUILT BY F. W. BLAUVELT.

Managing Broken Throttle Lever.

Editor:

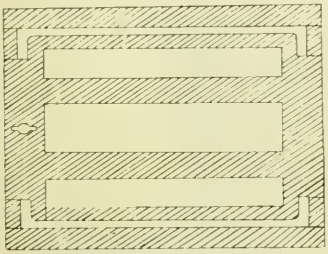
In your Catechism for Railroad Men, you give directions for engineers in case of accidents to throttle valve. Reading the article has reminded me of how an engineer I was firing for many years ago acted when a throttle lever stem broke. We were hauling an extra freight with our engine in bad order, when suddenly the throttle stem broke off about ¾ inch inside the gland with the valve closed. Uncoupling from train, Tom used the lubricator pipes to supply the cylinders

with sufficient steam to move the engine, so he managed to run her to the nearest station. While waiting for orders he got the engine onto a side track and proceeded to fix the engine.

The throttle-valve was the old V-pattern located in the smoke box. He found by experimenting a little, that by keeping the cylinder cocks closed and opening the tallow pipe valve, enough steam was admitted to the cylinders to nearly balance the throttle valve. He then screwed the gland up hard until the broken stem projected a little outside the gland. Then with an old chisel he flattened out the end of the stem until it closed the gland opening. By holding the stem in this manner, he was able to screw the gland out pulling the stem along with it, thereby opening the throttle. Working in this way he went for his train and took it in, a distance of thirty miles. He kept the throttle open and handled the engine with reverse lever and brake.

SOUTHERN ENGINEER.

Mobile, Ala.



Slide Valve Lubrication.

Editor:

Enclosed is a blue-print showing a device in relation to the lubrication of steam engine valves and valve seats. The openings shown on the valve seat lead to pipes furnished with valves to regulate the supply of steam and to make a force feed of the oil by the operation of a lubricator. The advantage of the device will be readily understood when it is observed that the oil is admitted into openings or ducts underneath the face of the valve. The location and dimensions of the openings for the admission of oil are such that the valve does not at any time travel beyond them. By this means it will be readily seen that the pressure of the steam in the steam chest has no effect on the free passage of the oil from the lubricator to the surfaces of the valve and valve seat, until the valve in its travel has passed over the opening, when the oil is carried into the cylinder at the beginning of the stroke of the piston. The oil is therefore positively distributed over the contacting faces of the valve and valve seat for a part of the valve stroke without any interference.

From this description it will be seen that there is a superior advantage over the ordinary method of distributing the oil over or above the valve. It also does away with the necessity of feeding oil into the valves and cylinders before the engine leaves a terminal, or while standing at sidings waiting for trains at meeting points. The amount of saving in oil is thereby very great, besides the wear of the valve and valve seat is reduced to a minimum.

Two years ago I had the good fortune to get an opportunity of applying the device on a western road, and the master mechanic reported to me in the middle of December that the valve seats and valves were still smooth and straight, with wear on valve seat less than 1-2000 of an inch, shown by projection of valve seat up into oil recess. The top pin of the rocker shaft was also almost the same as when put in. Everything, in fact, connected with the valve gear was in excellent condition with the exception of the bottom link pins, which on that particular engine were near the ground and would unavoidably be subjected to ready contact with dust and ashes.

Complete details of the device will be furnished to any of your readers who may be further interested in the matter.

D. MOREHOUSE,
C. & E. I. R. R.

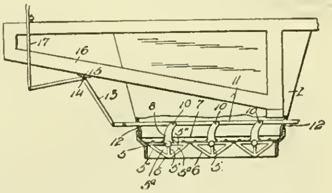
Villa Grove, Ill.

Improved Locomotive Ash Pan.

Since the adoption of the Federal law in regard to locomotive ash pans there have been a great number of devices looking towards a solution of the problem of cleaning the ash pan without the necessity of going into the pit under the locomotive. The fact that there has not been any special device that has met with universal approval is the best proof that the solution is not yet complete, or if it is it is not yet generally recognized. The hopper-shaped pans with sliding bottoms of heavy cast iron, and in some cases with thinner steel sliding plates which may be actuated by levers, are generally in use, but these are so varied in their attachments that it would be difficult to point to any particular design as being in more general use than another. As the winter advances the real test occurs of the efficiency of these types where the level sliding bottoms are in use. The severe frosts and the hardness of the snow on many roads render the efficiency of the apparatus difficult, and while some clever auxiliary devices in the way of steam pipes and other appliances calculated to thaw out the frozen parts and blow out the adhesive ashes are in use, their operations are attended with considerable difficulty and delay.

Among recent devices of the kind referred to, we had the pleasure of examining a form of ash pan designed by Mr. A. J. Brodhead, a machinist in the employ of the Pennsylvania Railroad at Pitcairn, Pa. As will be noted from the accompanying illustration the ash pan is of the hopper type. The chief variation consists, primarily, of the bottom of the pan being composed of a series of transversely arranged receptacles, which are V-shaped in cross section, and which are all pivotally mounted in a frame carried at the bottom of the pan. These receptacles are all connected and operated by a bar, which in turn is operably connected to a mechanism, by means of which all the receptacles may be tilted, rocked and dumped, the entire action being controllable from the firing portion of the locomotive.

The apparatus is of the most substantial kind. The bearings are enclosed so as to prevent any upward movement of the rocking parts. The appliance has also the advantage of great stability and may be lightly shaken so that small particles may sift through the spaces between the rocking pieces, or may be readily opened so that the entire contents of the ash pan may be speedily and completely emptied. The device is claimed to have stood the test of the severe weather last month without encountering the slightest difficulty of any kind. Mr. Brodhead has secured a patent for his device, and expects to have a number in operation at an early date.



BRODHEAD'S LOCOMOTIVE ASH PAN.

Device Which Eliminates Bolts and Fishplates.

Amos H. Staudt, of Hainton, Pa., has been granted a patent on a railroad coupling for fastening together the ends of rails without the use of bolts or fishplates, the connection being such that without removing the rail spikes it will be impossible for the meeting ends of the rails to become deflected. One merit claimed for the device is the prevention of accidents from non-aligning rails. Wreckers will not be able to separate adjoining rails without first unspiking both and lifting them up.

The coupling is designed on the order of a bridge block provided with web-engaging plates curved on arcs whose centers lie within the terminals of the plates. Rahbets are formed in the ends of the rails and the ends have to be lifted in order to place the coupling, and for which neither bolts nor pins are necessary, thus doing away with the drilling of holes in the ends of the rails for the use of the common fishplate coupling.

Consolidation Locomotive on the Lehigh and New England R. R.

The Lehigh and New England Railroad has recently received four Consolidation type locomotives from the Baldwin Locomotive Works. Two of these are heavy engines carrying 204,650 lbs. on driving-wheels and developing a tractive force of 494,000 lbs.; while the other two are suitable for service on light track and bridges, as they carry 132,000 lbs. on driving-wheels and develop a tractive force of 31,900 lbs. In general, the two designs are similar. Both have boilers of the modified Wootten type, arranged to burn a mixture of buckwheat anthracite and soft coal; and in each case the steam distribution is controlled by balanced slide valves driven by Walschaerts gear.

The two heavy locomotives bear the road numbers 32 and 33, and are capable of handling 2,500 tons of cars and lading on a grade of 0.5 per cent. The boiler is built with a straight top, and has a shallow throat and vertical back head. The combustion chamber, frequently used in Wootten boilers, practically disappears in this case, as it has a length of only 6 ins. This is sufficient, however, to prevent the flame from acting too directly on the tube ends. The firebox is radially stayed, and the water space stays include 799 of the flexible type. These stay the greater portion of the throat and sides, and are used in the three upper transverse rows in the back head, and the two outside vertical rows. Firing is accomplished through a single opening, measuring 14 x 36 ins., and having a fire door arranged to swing open in two sections. The grate is of the rocking type, with three groups of bars running across the furnace. Each side group rocks in two sections. There is a drop plate at the front and back of the center group, and the intermediate bars are coupled to rock in one section. The ashpan is built of ¼-in. steel plate, with three hoppers having cast iron bottoms and slides. The slides can be operated from the firing deck.

The valve gear is arranged with a crosshead connection between the combining lever and valve rod. This crosshead has an offset lug so that the motion is transferred from the plane of the radius rod to that of the valve rod without the use of a rocker. The links are supported on longitudinal bearers of cast steel, outside the second pair of driving wheels. The cab is placed well forward over the boiler barrel, and its position is such that the reverse lever is ahead of the tumbling shaft; the two being connected by a short reach rod. The reverse shaft bearings are supported on the link bearings, and the reverse lever fulcrum is conveniently bolted to the right hand link bearing.

CONSOLIDATION TYPE LOCOMOTIVE FOR THE LEHIGH & NEW ENGLAND R. R.

R. L. Wyman, Master Mechanic. Baldwin Locomotive Works, Builders.

The frames, frame braces and spring rigging are arranged in accordance with the usual practice for engines of this type, and require no special comment. The firebox is placed well above the rear pair of wheels, and the mud ring is supported on wide expansion plates at the front and back.

The tender has a 12-in. channel frame, and the trucks are of the arch bar type with cast steel bolsters and "Standard" rolled steel wheels. The tank has a water bottom, and carries 8,000 gals. of water and 14 tons of fuel.

The following are the dimensions of the larger of the two engines. The designs are of interest because they represent the latest development of a type of locomotive which has proved unusually successful in the anthracite regions:

Gauge, 4 ft. 8½ ins.; cylinders, 23½ ins. x 30 ins.; valves, balanced slide.

Boiler.—Type, Wootten, straight; material, steel; diameter, 78 ins.; thickness of sheets, ⅞ in.; working pressure, 200 lbs.; fuel, soft and buckwheat coal; staying, radial.

Fire-box.—Material, steel; length, 126¼ ins.; width, 108¼ ins.; depth, front, 55 ins.; depth, back, 49 ins.; thickness of sheets, sides, ⅜ in.; thickness of sheets, back, ⅜ in.; thickness of sheets, crown, ⅜ in.; thickness of sheets, tube, ½ in.

Water space.—Front, 4 ins.; sides, 3½ ins.; back, 3½ ins.

Tubes.—Material, iron; thickness, No. 12 W. G.; number, 418; diameter, 2 ins.; length, 15 ft. 8 ins.

Heating surface.—Fire-box, 243 sq. ft.; tubes, 3,410 sq. ft.; total, 3,653 sq. ft.; grate area, 95 sq. ft.

Driving wheels.—Diameter, outside, 57 ins.; diameter, center, 50 ins.; journals, main, 10½ ins. x 12 ins.; journals, others, 10 ins. x 12 ins.

Engine truck wheels.—Diameter, 30 ins.; journals, 6 ins. x 10 ins.

Wheel base.—Driving, 16 ft.; rigid, 16 ft.; total engine, 25 ft.; total engine and tender, 58 ft. 8 ins.

Weight.—On driving wheels, 204,650 lbs.; on truck, 20,200 lbs.; total engine,

224,850 lbs.; total engine and tender, about 370,000 lbs.

Tender.—Wheels, number, 8; wheels, diameter, 33 ins.; journals, 5½ ins. x 10 ins.; tank capacity, 8,000 gals.; fuel capacity, 14 tons; service, freight.

Engine and the Heart.

The Latin word *ingenium*, which signifies heart, mind abilities or genius, was originally applied to any mechanical device or contrivance of an ingenious or complicated character. In the course of time the word became Anglicized into engine, and those who operated mechanical appliances were called engineers. Numerous machines have got their names from a corruption or abbreviation of the word *engine*, as, for instance, gin, jinny, etc., but of late years the name has been applied almost exclusively to prime movers.

"Locomotive," which is now used to denote locomotive engine, was first applied in the sense now generally used through George Stephenson naming one of his first engines "locomotion." The word was expressive and convenient and soon came into popular use. Some slight deviations from the word were common in early days. The Norris Locomotive Works, when first established announced that they intended building locomotors.

High Praise for Firemen.

An enthusiastic orator addressing a meeting of locomotive firemen, said: "The nearest work to that of the Almighty is the locomotive. The locomotive engineer of next decade will be an improvement on the present. He will read more and will know more about the wonderful piece of mechanism that he keeps in active operation. This Order sets an example for any man or set of men to follow. I hope to see the day when lodges of the firemen will be those of education and when each man will be able to step up to the black-board and demonstrate the proposition—given certain propositions how many tons will this locomotive haul at 50 miles an hour."

These words were spoken twenty-five years ago and the progress prophesied has not materialized, although Brother Carter and McNamee have striven hard toward the goal.

Habits of Mechanics.

Remember that the mechanic who studies and thinks, who mixes in good society and associates with refined people is the man who is certain to make his way in the world. A man of this character is generally self-reliant, industrious, obliging and courteous, attributes that constitute valuable capital in pushing the possessor upwards. Some mechanics look with envy upon the dapper clerk who wears a laundered shirt every day and never needs to soil his hands with black grease, but the ambitious self-helping mechanic is the man to be envied.

There is a reverse of the picture in the mechanic who never studies or thinks of his work, who seeks low associates and indulges in various dissipations, who is slouchy and unpleasant in person, who is shiftless and loaferish, discontented, discourteous and disobliging. These characteristics are not confined to mechanics, but for the sake of our young readers we say beware of falling into such practices, for they are certain barriers to success in life.

Huntsman, the Cast Steel Inventor.

Inventors of ingenious devices have been very fortunate in the United States in reaping the benefit of their ingenuity, although there have been exceptions where the man who soweth not did the reaping often of a golden harvest. As far back as our industries go, we can note the public sentiment which insisted that the inventor's work should be rewarded, although there were exceptions like that of Eli Whitney, who invented the cotton gin, and had the property of his ingenuity stolen by Southern rascals.

Public sentiment in favor of the inventor was much more powerful in the United States than it was in England, probably because there were more people trying to improve mechanical appliances in this country with a view to labor saving. There was a tendency among English manufacturers to look down upon an inventor who demanded royalty on any patented article, and the infringing of patents was regarded as being nothing criminal. That was why inventors were in the habit of keeping their inventions secret when that was possible.

When Huntsman invented the manufacture of cast steel, he kept the process secret, because he had no faith in the protection that patents could furnish. Although Huntsman's invention added immensely to the riches of England, his countrymen were remarkably slow in acknowledging that his steel was an improvement on the old cementation product. The cutlers of Sheffield obstinately refused to use Huntsman's cast steel because it was harder than blister steel.

Foiled in his endeavor to sell his steel at home, Huntsman turned his attention to foreign markets, and he soon found he could readily sell abroad all the steel that he could make. The merit of employing cast steel for general purposes belongs to the French, a people always quick to appreciate the advantages of a new discovery. For a time all the cast steel that Huntsman could make was exported to France.

Then natural retribution made itself manifest. The cutlery turned out by French makers from cast steel gradually grew so popular that danger became imminent of the seat of the fine cutlery trade moving itself from Sheffield to France. Then the sneaking cutlers of Yorkshire became alarmed and tried to obtain an order from the government prohibiting the exportation of cast steel. That was refused and the Sheffield cutlers had to begin using the cast steel, but they tried all in their power to prevent Huntsman from receiving credit for his most valuable invention. For years the Sheffield ingrates were in the habit of attributing the invention of cast steel to a variety of pirates, but never a word about Huntsman's work. His own countrymen never did Huntsman justice until a Frenchman, M. Le Play published a report on steel making in the *Annals des Mines*, which vindicated Huntsman's name. Verily a prophet hath no honor in his own country.

The "Futility of Technical Schools."

This is the name of a pamphlet recently published containing an address by R. T. Crane to college students, which points out the waste of time that results to youths intended for a career connected with mechanics and manufacturing, electrical and civil engineering, spending years in acquiring a college education. It is a most sensible address, but we think it might have produced better results had it been poured into the ears of the mammas of the students who do so much to have their sons cast into the realms of gentility bearing the stamp of a college education.

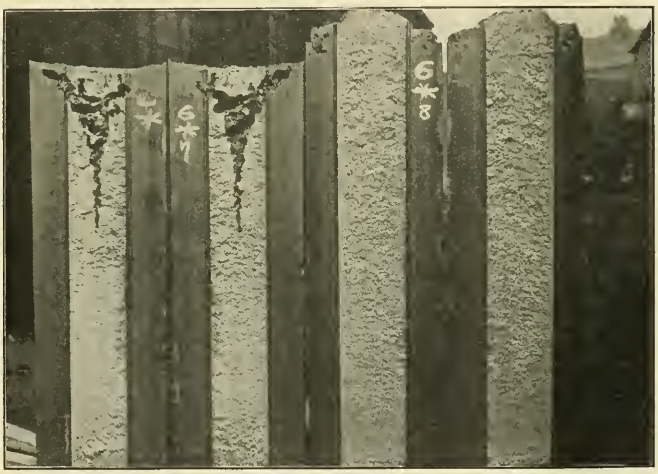
"Learn young, learn fair," is a good old Scots proverb, which is peculiarly applicable to those who wish to acquire a business based on handicraft or manipulative skill. The promoters of college education hoped that graduates would become leaders in the industrial world without enduring the hardships of shop work, but they have been disappointed. Even in electrical shops, where it was expected this would prove successful, they have failed. The General Electric Company gave technical students a thorough trial, but the president has now announced that technical school graduates are no longer wanted. They do not make skilful mechanics. The royal road to learning a trade leads to failure.

On the whole, we think the young man who becomes an apprentice when fourteen or fifteen years of age and proceeds earnestly to learn a mechanical trade has the brightest prospects for becoming a future captain of industry. He must learn the scientific part of his business, but that may be acquired through a correspondence school or by attendance at night schools.

Jessop's Steel Works at Sheffield.

By George Sherwood Hodgins.

The steel works of William Jessop & Sons, Ltd., are situated at Brightside, one of the wards of the city of Sheffield, in England, the name Brightside being that of one of the adjoining townships. The historic city of Sheffield is at the confluence of the rivers Don and Sheaf, and the name of the city is probably derived from the fields of grain on the banks of the river Sheaf. The coat of arms of the city shows in the lower part three garbs or sheafs of wheat on a green ground, while one of the early industries is typified by eight interlaced arrows. It is believed that the success of the English archers at the battles of Poictiers and later at Agincourt were largely attributable to the superiority of the Sheffield arrows. The victory at the battle of Bosworth is also ascribed to Sheffield arrows being, "longer, sharper, better ground and more highly polished" than those made before Sheffield knives have had an ancient and deserved fame.



STEEL INGOTS, SHOWING "PIPE" FORMATION ON TWO AT LEFT.

The steel works of William Jessop were established in 1774. In 1875 the business was converted into a limited company. The area covered is 45 acres and about 1,700 men are employed. The product is principally crucible steel of high quality, though about 30 years ago a fine steel foundry was erected in which the Siemens-Martin acid process is used in the manufacture of steel castings which range from 1 lb. to 60 long tons. Ten years later a heavy forge was added and an extensive machine shop was put in operation shortly after. In addition to other work this company makes 50 tons of crucible tool steel every working day, and the number of crucibles used daily amounts to 600. Steel bars ⅛ in. in diameter and strips .003 of an inch thick are only the smaller sizes of what is constantly turned out. This latter figure represents a thickness only comparable to that of a piece of tissue paper.

The process of making crucible steel as carried out by Jessop & Sons is very interesting and was recently shown to a representative of Railway and Locomotive Engineering. In order to insure the highest quality, the company buy the entire output of the best make of Swedish bar iron. This is as far as is known the purest iron in the world. The Swedish iron comes in bars ⅝ in. x 3 ins., and is converted into blister steel at the Jessop works. A layer of bars is placed on a bed of charcoal in the converting furnace, and on top of the layer of iron, another layer of charcoal is put on. This is repeated until the furnace is full. A coal fire below, the flames of which pass up into the converting furnace, soon causes the charcoal and iron to glow The fire is kept up from 10 to 14 days, after which the furnace is emptied. The charcoal has now entered into chemical union with the iron and the bars come out of the furnace as blister steel.

The blister steel is next broken into pieces, perhaps 2 or 3 ft. long, and the exposed fracture is examined by a skilled workman and the steel is, by him, graded according to how deeply the carbon has penetrated into the bar. "Steel Through" is the name given at the works to the bars in which the carbon has mingled completely with the iron. After the steel has been graded it is again broken up into small pieces of such size that they may be placed conveniently in a crucible of about 10 or 12 ins. in diameter. The various grades are kept in separate sets of crucibles, so that the contents of any set will be practically alike. Tungsten and chromium are added when necessary, separately or together and in such quantities as the resulting product may require.

In pouring, or more technically, in "teaming" the melted steel; from 80 to 100 crucibles are emptied to form two ingots of about a ton weight each. The crucibles with their contents are drawn up from their white hot pits by workmen who, one would think, did not even feel the terrible heat when the lid of the melting furnace is thrown back. The crucible is scarcely out of the lifting tongs before it is grasped by the forceps of the little carriage by which another workman runs it to the mouth of the huge ladle that is ready to receive it. The carriage itself is an ingenious device by which the crucible is firmly held, lifted up about an inch from the ground and moved at once to the mouth of the ladle. The carriage is so constructed as to provide for the tilting of the crucible in the act of emptying it, without loosing its grip and without the operator having to raise or lower the handles of the carriage.

The ingot moulds, two together, are below the surface of the shop floor. Each mould is made in two halves which are separated by strips of metal about 2 ins. wide. These strips have eye-bolts in the top so that they can be lifted out of from between the half mould, and the two halves can be forced together by hydraulic pressure according to the Robinson-Rodgers method as employed at the works. The illustration here given shows the "pipe" formed in the two ingots on the left of the picture, and two which have been subjected to pressure, after removal of the strips. The effect of this hydraulic pressure on the walls of the ingot, delivered up to 100 tons, while the steel is in a viscous or pasty condition, is to counteract the effect of contraction due to the mass of metal cooling, and so prevent the formation of a "pipe." It also has the effect of squeezing any impurities out of the body of the ingot and forcing them to the surface, where they are readily cut off. The result of this process is to give the ingot a uniform structure throughout and to insure a close-grained solid mass of steel, in which the portion requiring to be cut off before forging is very much reduced. Test samples are taken from the ladle as the pouring is concluded, and the ingots are not used until pronounced satisfactory by the experts in the company's laboratory.

The whole process is carried out with the most scrupulous care, the effort made all through is to secure the highest quality of tool steel and to secure a uniformity of output which is above question. It has been said that careful analysists can ascertain what are the exact ingredients and what are the precise quantities in which they exist, in milk or other or-

ganic substance, which, while it resembles milk, is not identical with it; so it is in the manufacture of any high-grade steel; chemical analysis may show good results in many cases, but there is a something, a "body," or whatever it may be called, which appears only in a test of actual service and this something is secured only by the use of the very best materials and the most scientific and painstaking methods of manufacture, a process in short in which no detail is overlooked and no deviations from the standard practice is permitted.

Space will not permit of a minute account of the making of cast steel by the acid process, suffice it to say that the same careful considerations of all the factors in the production of high-grade cast steel is manifested all the way through, as it is in the making of steel for tools, automobile crank-shafts, bars of various sections and the many purposes for which this steel is used. The "B-4-Any" and the "Ark" brands, as their names imply, are in the front rank and on the crest of the wave among the many excellent steels made today. The courtesy and kindly treatment which the Jessop Company give, alike to customers and visitors, will long be remembered by those who have the good fortune to deal with them in either capacity.

In addition to the above, the rolling mills, hammers and forges are well equipped and extensive enough to carry out any and all requirements for any commercial size or quantity of work.

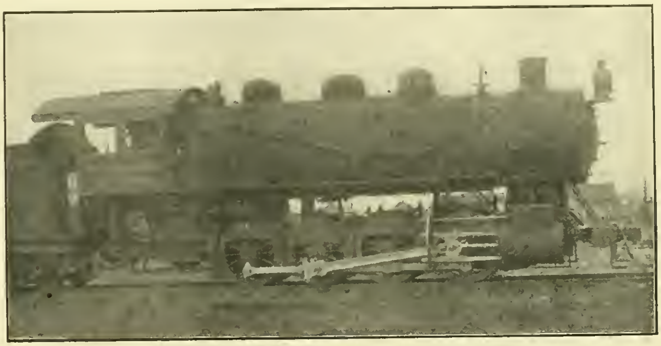
Monorail Line a Failure.

The monorail line, which consists of one mile of track from City Island, New York, to Bartow, has collapsed, financially. It looked great—on paper, but in actual practice it almost always failed to work Fortunately people who ventured into the aerial swing were furnished with a transfer to the adjacent horse cars. It was said that the horses winked at each other, but this is only a joke as there was little or no horse sense shown in the project. The monorail as a toy is a pronounced success, but as a means of carrying passengers or freight, its capability has not yet been demonstrated. Mortgages amounting to $55,000, on which no interest has been paid for several years, and a dilapidated equipment resembling a decayed barbed wire fence is all that is visible to the naked eye. The eye of faith, of course, may be able to see that trial is better than triumph, just as hope is better than achievement.

Heavy traffic is taxing the motive power of the Reading and the need of more engines is very great. Coal movements from the West are very heavy, and much general freight is being received from New York State.

Excellent Record of Lima Locomotives.

Last year the Chicago & Western Indiana Railway have had in service ten 24 x 28 eight wheel switchers built by the Lima Locomotive & Machine Company, of Lima, Ohio. These locomotives have been giving excellent satisfaction, and the railroad company are well pleased with the first-class material and workmanship embodied in construction of same. The order was filled by the locomotive company in three months. This was an excellent record for any locomotive works to deliver on exact time agreed upon. The following is a general description of the locomotives as built at the Lima works:



EIGHT-WHEEL SWITCHERS FOR THE CHICAGO & WESTERN INDIANA R. R.
Lima Locomotive and Machine Co., Builders.

Tractive effort, 43,290 lbs.

Weight on drivers, 201,000 lbs.

Weight engine and tender, 342,500 lbs.

Wheel base.—Driving, 15 ft. 6 ins.; engine and tender, 51 ft. 4 ins.

Diameter drivers, 57 ins., all flanged 5½ ins. wide; main driving axles, 10 ins. x 13 ins.; others, 9½ ins. x 13 ins.

Cylinders, simple, 24 ins. x 28 ins.

Valve gear, Stephenson.

Steam pressure, 180 lbs.

Boiler type, extended wagontop, wide fire-box.

Boiler.—Diam. smallest ring, 74⅜ ins.; diam. at wagontop, 80¾ ins.

Heating surface.—Fire-box, 165.95 sq. ft.; tubes, 2,832.14 sq. ft.; total, 2,998.09 sq. ft.

Grate area, 41.2 sq. ft.

Fire-box.—Length, 108 1-16 ins.; width, 60¼ ins.

Fuel, bituminous coal.

Tubes, "Mabo" steel, 327 2¼ ins. x 14 ft. 9 9-16 ins. over sheets.

Tender.—Coal capacity, 11 tons; water capacity, 7,400 gals.

Brakes: Westinghouse American No. 6 ET Equipment, 8½ in. Cross Compound Pump.

Bettendorf tender truck side frames and spring planks.

Sharon couplers, Ohio injectors, Chicago C lubricator, Crosby pop valves,

Fortune-Bearing Sand.

In the black sand found so profusely on the sea coast of California and Oregon zircon is found, which is used in the manufacture of the incandescent cylinders for the Nernst glow light. Among other minerals they contain are columbite, olivine and garnet, not to mention magnetic iron ore in large quantities. This iron is being substituted for carbon in the sticks of arc lights, burning one hundred and fifty hours, instead of a single night. It is destined to be used on an enormous scale for the manufacture of steel by electric smelting processes in the West, where fuel is costly and electricity derivable from water power is cheap.

Slow Politicians When Depew Was a Student.

Speaking at a railroad men's meeting Chauncey M. Depew indulged in some entertaining reminiscences on the stimulating effect of railroads, one of them being:

"While I was a student at Yale I used to go home during my vacation, and a favorite resort of mine in Peekskill was the village drug store, which was the resort of the village politicians. The oracle of this place thought he was a lawyer and was constantly debating with others as to whether the powers of the Constitution permitted the Federal Government to exercise certain authority over railroads.

"I said to him once: 'John, such and such a provision of the Constitution gives that power to the government.' He was of a different opinion, but said that he would look it up when he went home. It was ten years afterwards that I was again in that drug store and I found the old oracle in the same seat.

"'John,' I said, 'I think that I remarked to you last time I was here that there is a direct provision of the Constitution giving certain powers to the government which we discussed at the time.' 'I remember,' he said, 'but I have not yet had time to look it up.'"

It takes some politicians a long time to get a move on them.

Questions Answered

FORMULA FOR CYLINDER PROPORTIONS.

117. A. M., Hornell, N. Y., writes: A party of us were talking about the size of cylinders used on some recent locomotives illustrated in your paper and the assertion was made that the Master Mechanics' Association have a formula for size of cylinders in proportion to other parts. Will you favor us by publishing that formula? A.—The formula referred to is not one of the Master Mechanics' Association standards, but one was recommended by a committee of the Association which reads:

$$W = \frac{\qquad\qquad}{D}$$

which means square the diameter of the cylinders in inches, multiply by strokes of cylinder in inches, multiply by P which is 0.85 of the boiler pressure, multiply by C, which is 4 for passenger engines, 4.25 for freight engines, and 4.5 for switch engines, then divide by D the diameter of the driving wheels in inches. That will give the proper weight of the engine.

HORSE POWER OF LOCOMOTIVE BOILERS.

118. R. M. C., Cincinnati, O., writes: I have had a dispute with an engineer who says there is no way of figuring out the horse power of a locomotive boiler. I say it can be figured if one knows the proper rules. What do you say about the question? A.—We do not think that any rule exists for figuring the horse power of a locomotive boiler. The rule for stationary boilers with natural draft is the capacity to evaporate 3½ lbs. of water per hour from and at 212 degs. Fahr., which represents one horse power. Designers of locomotives provide a certain area of heating surface and grate area to meet the cylinder capacity and they pay no attention to horse power.

PROBLEM OF A REVOLVING DISK.

119. Apprentice, Buffalo, N. Y., writes: Why is it that an emery wheel out of true works out of balance with violent vibrations shortly after starting, and then after the speed, settles down to business without perceptible jar? I would like to have the thing mathematically demonstrated. Also, why is it that if you run an unbalanced disk at a speed of 300 revolutions per minute, the heavy side will be marked by a piece of chalk held to touch the circle of rotation, and when the speed is increased to 600 revolutions per minute the light side will touch the chalk? An explanation of this mechanical paradox would oblige many of your readers. A.—We regret to say that we cannot give this explanation. If any of our readers can show us how to demonstrate the puzzle we will gladly publish it.

HOLES IN COMBINING TUBE.

120. W. P., Somerville, Mass., writes: What use are the holes in the combining tube of an injector? I observe that some injectors have none of the small holes, while others have.—A. The holes are supposed to lessen the shock when a rapidly moving jet of steam strikes the heavier and slower moving body of water. The holes serve the double purpose of auxiliary overflow, as well as lessening the shock referred to. The water passing out of the holes finds its way out of the main overflow. It is also proved by experiment that the pressure of the holes enables the injector to work with water of a higher temperature than when there are no holes in the combining tube, but the chief reason for the holes is, as we have stated, to lessen the shock in the injector.

EXHAUST PIPES.

121. J. M., Belfast, Ireland, asks: (1) Will an obstruction, say, for instance, of a pipe emerging into area at base of chimney to the extent of 3 or 4 inches, cause any ill effects to the useful application of the cone of steam emerging from exhaust pipe?—A. It will affect the draft in the chimney to the extent of the ratio of space occupied by the projecting pipe. (2) Why are exhaust pipe tops invariably one-fourth of the cylinder diameter, and what is the theoretical idea regarding the creation of vacuum for the escaping steam through chimney?—A. The size of exhaust pipe top openings are, in common with many other mechanical appliances on engines, the result of many experiments made in quest of what is most suitable. The theory as well as the practice of creating a vacuum by means of the exhaust is to adopt the size of the opening on the exhaust pipe so that the jet of escaping exhausted steam will completely fill the chimney or smokestack, each successive blast acting like a piston and inducing a current of air to pass rapidly through the fire.

PISTON VERSUS SLIDE VALVES

122. A. B., St. Thomas, Ont., asks: To what is the great popularity of the piston valve in locomotive use due to when several railroads throughout the country would have, apparently, nothing else than the good old-fashioned slide valve. A.—The advantage of the piston valve over the slide valve is in the balancing of the valve. The circular form of the piston valve precludes the possibility of any great pressure of steam affecting the movement of the valve. In the case of the slide valve even if the upper surface of the slide valve is covered by balancing appliances, there remains a considerable exposed surface which weighs heavily on the valve face and valve seat when the steam is applied. This additional friction must be overcome by using some of the power of the engine, which in the case of the piston valve can be used for other purposes. Some minor details are in favor of the slide valve. It is the least liable to damage of the two, especially in the case of water in the cylinders. A compression of water will readily break the piston valve rings, but will only temporarily lift the slide valve from its seat. The action of both kinds of valves in opening and closing the steam ports are identical.

POINT OF EXHAUST.

123. J. W. W., Streator, Ill., writes: I noticed in a paper of recent date here the following question: An engine having 3 ft. 6 in. stroke, valve travel 10 ins., with ⅛-in. lead and 2 ins. outside lap, how far will the steam follow the piston? My answer would be 34.5 ins. The answer as given was 34.67 ins. Which is right? A.—Neither the one nor the other is right, that is, assuming that there is no inside lap on the valve. It will be readily noted that a valve traveling 10 ins. must necessarily travel 5 ins. on each side of the center. In the case referred to the valve has already traveled 2⅛ ins. before the piston has begun moving from its extreme point of travel. The valve has therefore 2⅞ ins. further to travel before reversing its movement, after which it must travel 5 ins. before reaching the center at which point the exhaust port would begin to open. The valve would, therefore, travel 7⅞ ins. The relation of 10 ins., the entire travel of the valve, to 7⅞ ins. being as 80 is to 63, so would 42 ins. be to 33.075 ins., the distance traveled by the piston when the exhaust begins to open.

COMMON AND MALLET COMPOUNDS.

124. G. C. B., Covington, Ky., asks: (1) What is the difference between an ordinary compound and a Mallet articulated compound? A.—The difference so far as the application of the steam to the pistons is concerned is in the arrangement of the steam pipes. In the ordinary compound locomotive the steam after passing through the high pressure cylinders is immediately admitted by means of an intercepting valve to the low pressure cylinder usually a part of the same casting as the high pressure cylinder. In the case of the Mallet articulated compound, an account of a considerable distance intervening between the high and low pressure cylinders, pipes are used to convey the steam after it has passed through the high-pressure cylinders to the low-pressure cylinders. These steam pipes are usually equipped with a flexible joint to adapt themselves to the swinging motion of the locomotive in curves. The high-pressure cylinders are placed about the center ot the locomotive and are usually supplied with steam directly from the dome, while

the low pressure cylinders are at the front end of the locomotive.

(2) Assuming one staybolt broke, what would be the extra stress thrown on the other stays at 210 lbs. pressure of steam? A.—Assuming that the stays are four inches apart, the area supported by each stay would equal sixteen square inches, or 33,600 lbs. In the case of a stay breaking, the pressure would be equally distributed among the adjoining eight stays, giving an added stress of 4,200 lbs. each. This added stress, however, does not rest entirely on the stays, as the tensile strength of the unsupported sheet has a resistance equal to 50,000 or 60,000 lbs. per square inch. Boiler sheets of ⅜ in. or ½ in. in thickness would have a correspondingly less ratio of resistance to the estimated resistance of that one inch in thickness.

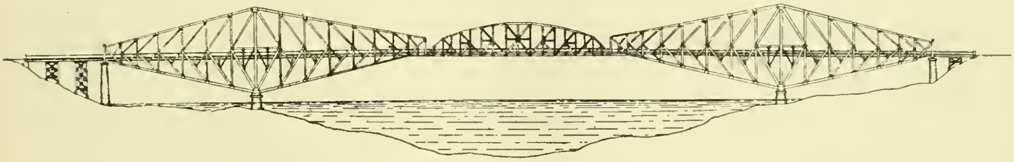
POINT OF CUT-OFF.

125. J. M. Belfast, Ireland, writes: A slide valve having no lead and cutting off at one-quarter of 24 ins. stroke, by shifting sheave to give valve lead, will cut off occur at same point or part of stroke as when valve had no lead? A.—No. The shifting of the eccentric in order to open the valve earlier will have the effect of opening the exhaust port earlier than if no change had been made. The amount of variation would be in a ratio of the stroke of the piston to the stroke of the valve.

Largest Cantilever Bridge in the World.

A contract has recently been let to the St. Lawrence Bridge Company for the construction of the superstructure of the Quebec birdge at $8,650,000. This, with the contract already let for the substructure, makes a total of about $12,000,000. The bridge is on the line of the Transcontinental Railway, where it crosses the St. Lawrence River, near Quebec, and it will be the largest cantilever bridge in the world, the suspension span being the longest single truss span ever designed. This span exceeds that of the celebrated Forth Bridge, Scotland, by 90 ft. In working out the design Mr. George P. Graham, minister of Railways in Canada, has had in consultation a commission of the world's most expert bridge engineers, and their work has extended over a period of two-and-a-half years. The only bridge over the St. Lawrence River east of Montreal, it will be used by the Transcontinental Railway and any others that may require it. It is expected that the bridge will be ready for traffic by 1915. The St. Lawrence Bridge Company, which succeeded in competition with German, English and United States firms, is a purely Canadian company, comprising the Dominion Bridge Company, Montreal, P. Q., and the Canadian Bridge Company, Walkerville, Ont. When completed the structure will be counted as one of Canada's greatest undertakings. K webb system is to be adopted for the cantilever and anchor arms, the suspended span being of a modified Pratt type. The total length of the structure is 3,228 ft., or about three-fifths of a mile, and the length of the centre span 1,800 ft. At the centre 110 ft. deep and 70 ft. at each end, the suspended span is 640 ft. long. The cantilever arms are 580 ft. long, 70 ft. deep at the end, and 310 ft. high over the main post. Anchor arms are 520 ft. long. Between the trusses the width of the bridge is 88 ft., and it will be 150 ft. above high water. In the centre of the river the depth of the water is 200 ft. All members in the anchor arms and those immediately over the main pier, as well as the floor arms, will be built of carbon steel, the cantilever arms and suspended span of nickel steel. All the piers are to be constructed of cement concrete below water, and of granite-faced masonry filled with cement concrete above water, the abutments being of granite masonry. Over the main pier on the south side the caisson will be 180 ft. by 55 ft. The north side is to be built in two sections, each caisson being 65 ft. long and 60 ft. wide. The bridge will accommodate a double track railway, and on each side have a four-foot sidewalk for foot passengers. Over 100,000 cubic yards of masonry will be included in the piers and abutments, and the weight of steel in the superstructure is estimated at about 45,000 tons. Transportation of this immense quantity of steel will require the use of 1,667 freight cars of 60,000 lbs. capacity, or 67 trains of 25 cars each. The construction of this remarkable bridge is due to the enterprise of the Grand Trunk Pacific Railway. The work is being as rapidly proceeded with as the climate conditions will permit.

It will be recalled that the work on a bridge at this point was well advanced several years ago, when a portion of the work collapsed. It need hardly be added that the new bridge will be of much more substantial proportions.



PROPOSED NEW BRIDGE OVER THE ST. LAWRENCE RIVER AT QUEBEC, CANADA.

Muck Bar Iron.

At a meeting of a railway club some of the highly practical members were thrown into consternation when they were asked to answer the question: "What is muck bar iron?" We feel inclined to review this incident because there is a revival of interest in metallurgical subjects among railway men at present.

Very few mechanical officials would confess that they did not understand all about muck bar iron, yet when the writer asked for particulars no one at the meeting was able to explain the difference between muck bar and any other iron.

Being in the position of ignorance about muck bar that pervaded the meeting, we consulted an engineering dictionary when we reached home, and found that muck bar iron is the first product of a puddling-furnace. A mass of cast iron is placed in a furnace and exposed to a high heat in the presence of oxygen. When the iron melts, a workman keeps stirring the mass with a hooked bar called a rabble. The carbon present in the cast iron combines with the oxygen in the hot blast, and other impurities are carried off by flux provided for the purpose. The workman keeps stirring the mass, and by degrees the iron forms into a pasty mass. This is separated into balls which are removed from the furnace and passed through squeezers that force out a great part of the slag and cinder that had remained among the iron.

The iron is next passed through "muck rolls," after which it is called muck iron. When that iron is reheated and again rolled into bars it becomes bar iron. After more manipulation it becomes refined iron.

Wasted Opportunity.

It is probable that in no other portion of the world are coal, iron ore, and limestones so plentiful and so widely distributed as they are in Siberia, and in no other portion of the world has their development been so much neglected. It was supposed that the opening of the Siberian Railway would promote enterprise but it seems to have had no effect. The railway people have difficulty in procuring coal sufficient for the use of their locomotives at a high price and wood is almost universally used for domestic purposes.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances.

Published Monthly by

ANGUS SINCLAIR CO.

114 Liberty Street, New York.

Telephone, 746 Rector.

Cable Address, "Locong," N. Y.
Glasgow, "Locoauto."

Businese Department:

ANGUS SINCLAIR, D. E., Prest. and Treas.
JAMES KENNEDY, Vice-President.
HARRY A. KENNEY, Secy. and Gen. Mgr.

Editorial Department:

ANGUS SINCLAIR, D. E., Editor.
JAMES KENNEDY, Managing Editor.
ALLEN G. WOOD, Consulting Engineer.
GEO. W. KIEHM, Associate Editor.
A. J. MANSON, Associate Editor.

Western Representative:

J. A. CASSELL, 127 No. Dearborn St., Chicago, Ill.

Boston Representative:

S. I. CARPENTER, 648 Old South Building, Boston, Mass.

London Representative:

THE LOCOMOTIVE PUBLISHING CO., Ltd., 8 Amen Corner, Paternoster Row, London, E. C.

Glasgow Representative:

A. F. SINCLAIR, 15 Manor Road, Bellahouston, Glasgaw.

SUBSCRIPTION PRICE

$2.00 *per year,* $1.00 *for six months, postage paid in the United States, Canada and Mexico. For other parts of the world,* $2.50, *or ten shillings. Single copies,* 20 *cents. Remit by Express Money Order, Draft, Post Office Order or Registered Letter.*

Mailing address can be changed as often as necessary—always give old and new address, and if you subscribe in a club, state the name of the agent.

Please give prompt notice when your paper fails to reach you regularly.

Entered at the Post Office, New York, as Second-class Mail Matter.

Inventions.

Few industrial concerns offer so wide a scope to the inventor as railways do. The various mechanical appliances necessary for the equipment, maintenance and operation of a railway system have afforded and still afford almost unlimited opportunities for the exercise of inventive genius, and numerous inventions are continually submitted to the railway companies. The majority are obviously the outcome of careful thought, but while this remark applies to the inventions, little regard is paid to the actual requirements. For example, a large number of specifications are received for the automatic locking of railway carriage doors, although there are obvious objections to the adoption of any such device. Indeed, the President of the Board of Trade has stated in the House of Commons that he "hesitated to recommend" the use of such a lock. The first duty of the inventor, therefore, is to satisfy himself that his idea relates to a necessary appliance, as otherwise the time spent on its development will be wasted.

Generally speaking, inventions now represent improvements on devices already in use, and in regard to these inventors would do well to consider whether the contrivance is more effective, more durable, or equally effective and durable. and producible at less cost than the appliance which it is designed to supersede. If neither of these advantages can be claimed, the chance of success is remote indeed.

The Utility of Railroad Clubs.

The growing importance of railroad clubs is one of the marked features of our time, and their advantages are in keeping with the progressive spirit of the age. The time when almost every man engaged in scientific or mechanical research kept his own secrets is happily disappearing, and it is not now a mere matter of divulging some advanced means or methods of work when it became a matter of sheer necessity for personal ends, but it is a matter of pride and pleasure to be able to add something to the growing stock of knowledge in regard to the best means of obtaining better results.

As is well known on the rapidly expanding realm of railroad traffic there still remains a wide field in which mechanical ingenuity can exercise its inventive faculty. Not only in the special domain of mechanical appliances, but in all the multiplex details of the work of the transportation departments, there is a constantly widening sphere that calls for new means and new methods.

The railroad clubs give opportunities for the exchange of thoughts on these and kindred questions, and while it is true that periodical literature is rapidly taking the place of text books, and so maintains a constant stream of information on every conceivable question, which can be readily reached by the humblest artisan, there is a peculiarly vitalizing influence to be felt in the opportunity offered by the railroad club in getting in closer touch with the results of experience direct from the lips of those who have passed through a special experience, and who have been actively engaged in the physical and intellectual activity incident to the involved problems arising from railroad work. The advantages to the individual members may be briefly summarized as aiding by mental exercise in strengthening, the faculties of the mind, in learning how unexpected troubles may be overcome, in seeing how difficulties may be met, in observing how wider and infinitely vaster situations may be dealt with successfully. In addition to these may be added the important fact that intercourse with active, thoughtful men polishes the mind and engenders a kindlier courtesy in the relations of man to man.

These benefits have their corresponding reflex on the community of which the members are a part. The good that is to be gathered from the meetings of the railroad clubs tends to improve the conditions of life and work wherever the example or authority of the members extends. The public mind is better educated in regard to the world of science, and thus the thoughts that are gathered at the railroad clubs like seeds sown in the furrowed earth spring into full-blossomed utility.

Another fine feature of these clubs may be referred to as emphasizing the fact that the members almost invariably show their good sense in the selection of their officers. It is no mere hail fellow well met that is called to preside at such meetings, but men generally who have distinguished themselves in some real work and who may be expected not only to bring out what is best and brightest in the members, but who may add to the general fund of information facts gathered from experience and present them with a degree of grace and forcefulness that may serve as an example to the less experienced.

Stresses on Bolts.

Some people believe that no skill is involved in such an operation as severing the nuts upon a cylinder head or other part where uniformity of strain produces durability and lightness of a joint. It is such a simple operation that the unthinking man assumes that it calls for no skill and little care. That is where he is mistaken.

It cannot be too clearly remembered that bolts should always be tightened up to a tension somewhat greater than the greatest load which will come upon them. Take, for example, the bolts of a steam cylinder head. With a 20-in. cylinder of a common steam engine there may be ten bolts, and at 50 lbs. pressure the load on each bolt will be approximately 1,600 lbs. With ¾-in. bolts we cannot safely figure up the area at the base of the thread to more than one-third of a square inch, so that the load on each square inch of bolt area is 4,800 pounds. Good iron will bear safely for an unlimited period a steady stress of 20,000 lbs., but it is necessary to use lower working stresses than this on account of the severe torsional strains brought into action too frequently by the injudicious and careless use of a long wrench in the hands of ignorant or careless workmen who too frequently imagine that a cylinder head needs to be screwed down to such an extent that the flanges are warped by the pressure of the nuts and the faced joint spring out of truth. This is mistaken practice. The

bolts should be tightened to something over the 1,600 lbs., but ought not to be one iota tighter than will just serve to prevent steam from leaking through the joint, and the wrench should be used with moderation and not as though meant as a test of the torsional strength of the bolts. When they are employed to hold together the parts of a structure, it is important that the same rules be observed, and the initial tension of the bolts must always be something in excess of the load carried. If not made so, the stretch of the bolts under the working load will cause them to slacken and a minute separation of the surfaces bolted together will take place, as there will be an oscillatory stress on the bolts which will be far more destructive than the steady stress due to initial tension.

Pegs in the Wrong Holes.

People who have habits of observation are constantly meeting individuals who have mistaken their natural vocation mostly through an egotistical belief that nature intended them to play a heroic role in life. True freedom demands stern discipline, and in nothing so much as in finding and keeping our right places and doing our right work. It was once said of an ambitious man who had left a good trade to study divinity, that he had spoiled an excellent shoemaker to make a very poor preacher; and this kind of work is constantly going on in various directions. Youths who might have made their mark as masons, carpenters or machinists sink into utter insignificance as pettifogging lawyers, incompetent physicians, or inferior tradesmen. The man who had it in him to become a scientific farmer turns himself into a third-rate bookkeeper, and the other, who might easily have worked his way up to the head of a large manufactory, struggles with poverty in an attic, writing what no one cares to read.

Sneer at the Engine Indicator.

If the steam engine indicator were used more freely on our locomotives there would be fewer of this type of steam engine limping through the country, proclaiming that their valves were out of square. A college graduate of our acquaintance had been noting the irregular exhaust of the locomotives on a certain railroad and he asked the master mechanic if his people ever applied an indicator to their locomotives, and was told that their locomotives were built to pull cars, not indicators.

That was the retort of egotistical ignorance. From the lessons learned by long experience in handling the steam engine indicator we know that its testimony concerning the distribution of steam in locomotive cylinders has been the means of saving much heat, especially in cases where the valves were out of square or where obstructions existed in the steam passages. The trouble with the use of the indicator on locomotives has been that it was most frequently applied to the best working engines for the purpose of being able to boast about the fine care taken. To make the use of the indicator pay it should be applied to locomotives that are running down and would be improved by the adjustments which the indicator diagrams would suggest.

Old Times on the Erie.

An old superintendent, recalling early days on the Erie, where so many railroad officials learned their business, said: "Conductors in those days made up their own trains and switched them; checked their own bills and selected the engines they intended to haul their train. The unwritten rule of the service was that the first man on an engine in the engine house at Piermont was the man entitled to the engine for the round trip to Port Jervis and return. There was all the difference in the world in the engines, and there was great rivalry among the conductors to get the best engines. I have heard there was a young conductor who was so much on his job that as soon as he had swallowed his supper he would hurry to the engine house, make up a bed in the cab of his favorite engine and sleep there until the engineer came to take her out. The older men would curse that enterprising conductor, but he was of the stuff superintendents are made of, and he reached that position before he got rheumatism sleeping on engines.

The Grand Army of Inventors.

Not a few railway officials have found that their experience in the railway field has proved one excellent training as the introduction to a successful career in what is familiarly known as the railway supply business. It used to be that the men who left railroad life to sell goods were persons who had been unfortunate and were left out in the cold against their will; but of late years we find officials in good standing, popular with high and low, relinquishing railway life to adopt the difficult position of traveling salesmen. We once heard a popular railway official, who had been successful as a master mechanic, declare in a railway club meeting that his interests were sending him into the railway supply business and that he was about to join "the grand army of cranks," meaning the men engaged in devising and promoting inventions.

We confess to entertaining a warm interest in, and kindly admiration for, the men who constitute the army referred to, and we have no sympathy whatever with the detractors and fault-finders who are ready to class every man as a crank who becomes strongly interested in advocating some particular invention. Humanity has in all ages been deeply indebted to the class of men who concentrate all their energies on advocating a particular idea, and civilization has received its strongest motive power from the men who have devoted their lives to forcing inventions upon an unwilling world.

The person whose feelings are so keen that a breath of opposition harrows them, the man with intellect is so nicely balanced that a rude word throws the possessor into confusion, is not endowed with the faculties necessary for leading the march of human progress. Such men never could have persisted in introducing the steam engine and thousands of other inventions scarcely less valuable as auxiliaries to a world that was not inclined to receive them. The circumstances which militated against the introduction, and raised up obstacles to the adoption of improvements in years long gone, hold good with more or less force in the present day, as the railroad world would have lost many of the most valuable efficiency, promoting expense-reducing and safety-promoting appliances in successful use had they not been advocated and pushed forward in season and out of season by men who were not discouraged by opposition or turned from their purpose by rude treatment.

The American railway world has paid fairly well for the use of patented devices, but nothing like what the appliances have brought in return by saving labor, promoting efficiency, preventing accidents and in prevention of waste. After an invention that reduces the cost of operation or eliminates dangerous conditions has been put into use and is supplied ready for attachment by manufacturers, it is common criticism to hear railway companies blamed for not producing the improvements themselves; but the difficulty is that railroad companies do not employ a monopoly of the inventive ability of the country. Until that condition of affairs comes about it will be cheaper for railroad companies to pay for inventions than to attempt raising and maintaining all the inventors needed for their own wants. Some foreign railway companies keep their inventors upon the pay roll with remarkably meagre returns.

Whenever the need of some improvement on our railway machinery becomes manifest, a whole army of inventors proceeds to work out what is needed. No army was so miserably paid, but there is a prize to be won, and the hope of gaining these prizes buoys the hopes of the many. When the various inventions are brought before the railroad world, those of leading merit are quickly selected, and those who fail return to their inventive labors hoping to be more successful next time; or the representative of a device which has failed, not through lack of merit, but

owing to circumstances that are not always creditable to those who have made the rejection, goes about insisting that his invention ought to be adopted, and for that persistency he is called a crank. The men who devote themselves to the improvement of certain lines of machinery become experts in the department of their choice, and in many instances such men are more competent to say what will work satisfactorily than the men in charge of the railway machinery of the country.

From the road bed to the top of the highest bridge there is no member of the railroad structure or article of railroad machinery that is not indebted for improvement to the grand army of inventors. Railroad machinery of all kinds is better adapted for the work it has to perform, safer for the transportation of passengers and freight, morè economical and more durable from the work done upon it by the great army of American inventors. The independent truck, the Miller platform, the Westinghouse air brake, the automatic coupler and all other safety appliances, the boiler feeding injector, efficient safety valves, automatic lubricators and pressure gauges were all developed by men outside of railroad service, and most of them were pushed into adoption by men who were regarded as persistent cranks of their day and generation, if that opprobrious word is going to be applied towards those who are single-minded believers in making things better, or in trying to teach their fellow men through the highest order of utilitarian preaching. May good fortune attend our grand army of inventors; the country would be poor indeed without them.

Source of Railroad Executives.

At one time in the history of railroading it was the general opinion and rule that only men trained in the operating department were fitted for the duties and responsibilities of a chief executive, and there was little use in those identified with other branches aspiring to the presidency of the road with which they were connected or any other.

But there came a change that has not only carried traffic men to the front and to commanding position, but even some who spent more time in the mechanical department have not only risen to president but have attained the same measure of success as marked their career in the lower grades of the service. This is not a new subject but it has again been brought conspicuously to general attention in a statement prepared by W. A. Garrett, chairman of the General Managers' Association of Chicago, and at one time vice-president of the Seaboard Air Line, and which shows the beginning of men who, today, are railroad presidents.

The list includes F. D. Underwood, of the Erie, who was a conductor; E. P. Ripley, of the Santa Fe, who was a ticket agent of the Galveston, Houston & Henderson; Oscar G. Murray, formerly president and now chairman of the Baltimore & Ohio directorate; Walter L. Ross, vice-president of the Alton, who in 1887 was an office boy in the employ of the Wabash; B. L. Winchell, of the Frisco and the Chicago and Eastern Illinois, who began in a clerical capacity in the traffic department of the Hannibal & St. Joseph in 1873; Darius Miller, of the Burlington, who, in 1880 was a stenographer in the general freight office of the Michigan Central; Charles M. Hays, of the Grand Trunk, started as a clerk in the passenger department of the old Atlantic & Pacific; B. D. Caldwell, now president of Wells-Fargo; his immediate predecessor, William Sproule, who has recently become president of the Southern Pacific; Daniel Willard, of the Baltimore & Ohio, who is a striking example of what the mechanical department can produce: W. C. Brown, of the New York Central Lines, who went through the grades of many departments before he reached the top of the ladder; W. H. Newman, whom Mr. Brown succeeded, and who is still associated with the same system in a responsible, though advisory way.

Twenty-fifth Anniversary Greetings.

In entering upon the twenty-fifth year of the publication of Railway and Locomotive Engineering, and wishing all of our readers great good fortune in the year that has just begun and in all the years that are to be, it occurs to us that it is proper and becoming to cast a glance backward as well as forward. We will be pardoned in stating that a great cause of satisfaction to us in the work in which we are engaged is the fact that we still have many hundreds of the names of the original subscribers on our lists. Many of them have risen to distinction in the railway world, and all of them have repeatedly expressed their sense of gratitude to us for the lessons they have learned from our pages. Our aim at the beginning was to help in the work of the better education of railway men employed in the mechanical department. That our work has been appreciated is amply shown by the warm support we have received from the most active and intelligent railway men in every civilized country in the world. We were never better equipped than now, and with the constantly increasing additions to our lists of readers and the continued warm support of the leading men in the railway world, we look confidently for a continuation of that popular approval which has come to us for so many years, and which in the expanding field in which our work lies cannot do other than broaden with advancing time. The past is full of achievement and the future is full of promise.

Reviews of Books and Official Reports

Progress and Prosperity, by William De Hertburn Washington. Published by the National Educational Publicity Co., New York. 887 pages, profusely illustrated, half morocco. Price, $4.50.

This comprehensive work embraces a history of the development of transportation from the earliest periods to the present time, and coincident with this interesting story is a review of the progress of the human race in the march of civilization. As may be expected, the steam engine receives a large share of the attention of the learned author, and the illustrations which accompany the letterpress descriptions are in themselves a panorama of the world's history that cannot fail to strike the most casual observer with the marked value of the publication. Mr. Washington's familiarity with the details of railroad work in all its complex phases renders his book a complete cyclopedia of railroad information, which should attract wide attention and commend itself to the leading railroad men. The style of the writer is admirably adapted to the subject. The letterpress, illustrations and binding are of the best.

The report of the proceedings of the Nineteenth Annual Convention of the International Railroad Master Blacksmiths' Association has just been published and forms a substantial volume of 250 pages. The book has been carefully edited by Mr. A. L. Woodworth, Lima, Ohio, and presents the reports of twelve separate committees on subjects rainging from the foreman and his men to flue welding and drop forging. The reports are all of much interest and the debates appended show how thoroughly the members of the association had covered the subjects under discussion.

The fourth annual report of the Public Service Commission of the Second district, State of New York, for the year 1910, has appeared in a volume of over 1,000 pages. As formerly the reports in relation to railroads fill the larger part of the volume, and much interesting information may be obtained by those who have time and patience to look through the mass of undigested matter. The boiler inspection departments reports are perhaps the most interesting as showing considerable data of real value. It also shows the inadequacy of the work of the commission, for of the 7,900 locomotive boilers in operation in New York State in 1910 only 2,649, or about one-third, were examined by the State inspectors.

Very likely the politicians need the money for other purposes.

Catechism of Railroad Operation

By Angus Sinclair

QUESTIONS AND ANSWERS.

Third Series Continued.

76.—What is a by-pass valve and what is its purpose?

A.—The by-pass valve controls the passage of a pipe placed outside the cylinder which connects the front and back steam ports. When an engine is drifting without steam, there is a tendency for the pistons to pump air—an objectionable thing which the by-pass valve helps to prevent. The suction of the piston opens the by-pass valve and the air from the other end of the cylinder is drawn through the by-pass pipes. So the action made possible by the by-pass valve and pipe is, to permit air to pass forth and back in the cylinders instead of having hot dusty air drawn through the exhaust pipe.

77.—What is a vacuum relief valve?

A.—That is a relief valve usually located in front of the steam chest to perform the same functions as a by-pass valve. This valve opens when steam is shut off and permits the piston to suck air when the engine is drifting. Its action feeds the vacuum made by the moving piston.

78.—What is a cylinder head relief valve?

A.—It is a safety valve located on the cylinder head for the purpose of relieving the cylinder from the effect of excessive pressure due to working water. It will also tend to prevent fracture of the cylinder from excessive pressure caused by reversing the engine when running fast.

79.—What is a slide valve and what action does it perform?

A.—An ordinary slide valve is a cast-iron box, used face downward, made to slide over the steam ports and exhaust port on the cylinder in such a way that it admits steam into the steam port and opens the exhaust port. Its sides are flat and of sufficient width to extend (lap) some distance over the steam ports when upon the middle of the valve seat. There is a hollow recess in the middle of the valve called the exhaust cavity, which acts as a passageway for the exhaust steam.

80.—What is a balanced slide valve?

A.—A balanced slide valve is provided with means for preventing the steam in the steam chest from putting its full pressure upon the whole of the upper surface of the valve. The balancing feature is obtained by means of a flat plate secured to the steam chest cover and extending beyond the extreme travel of the valve. The Richardson balanced valve has the top grooved near its four upper edges for holding four nicely fitting iron strips which are supported against the balancing plate by semi-elliptic springs making a steam tight joint and prevent steam from reaching the enclosed part of the valve.

The American balanced valve obtains the same results by means of circular tapering rings supported by coiled springs.

81.—What is the purpose of the small hole drilled through the top of all balanced slide valves?

A.—The purpose of that hole is to permit any steam or water that may find its way inside of the balancing device to escape into the exhaust passage. It also helps in permitting lubricants to reach the rubbing surfaces.

82.—What is a piston valve?

A.—A piston valve is a cylindrical spool-shaped device, that has a rod carrying two piston heads having cast-iron packing rings sprung into place on the heads, and operating in a cylinder of equal diameter. The valve cylinder takes the place of the old steam chest, and is provided with suitable admission and exhaust ports which cause the piston valve to perform the same duties as an ordinary slide valve.

83.—What is meant by inside and outside admission of valves?

A.—In an inside admission valve the steam enters the steam port of the cylinder from the inside edge of the valve and is exhausted from the outside edge of the valve, reversing the operation that goes on with a common slide valve. With outside admission the steam enters the engine ports outside of the valve edge, and exhausts under the inside of the valves.

84.—What is the relative motion of piston and valve for inside admission valve and for outside admission valve?

A.—With inside admission of steam, the motion of the valve is in the opposite direction to the piston's movement at the beginning of the stroke. With outside admission of steam the movement of the valve is in the same direction as that of the piston at the beginning of the stroke.

85.—What is the difference in the valve motion for outside admission valves and for inside admission valves?

A.—There is not necessarily any difference in the valve motion.

86.—What is a direct motion valve gear?

A.—One in which the movement that actuates the valve is transmitted direct without the intervention of a rocker.

87.—What is an indirect valve motion?

A.—One in which the eccentric or its equivalent transmits motion through a link to a rocker arm which in turn operates the valve stem. Nearly all link motions on the American Continent are indirect. In Europe nearly all link motion is direct acting.

88.—What is meant by valve lead?

A.—Lead is the amount of opening a valve has when the piston is at the beginning of the stroke.

89.—What is valve lap?

A.—There are two kinds of valve lap. One is known as outside lap, the other as inside lap.

90.—Explain the features of outside and inside lap.

A.—Outside lap is the amount the valve overlaps outside the steam ports when the valve is on the middle of the seat. Inside lap is the amount the inside edges of the valve overlaps the steam ports when the valve is set on the middle of the valve seat.

91.—What is exhaust side valve clearance?

A.—Exhaust side clearance is the amount the inside edge of the valve comes short of covering the steam ports when the valve is on the middle of the seat.

92.—With an indirect valve motion, what would be the position of the eccentric relative to the crank pin?

A.—If the valves are inside admission indirect requiring the use of a rocker shaft, the eccentrics would lean toward the fire box when the main crank pin is on the forward dead center; while an outside admission indirect motion has the full part of the eccentrics leaning toward the main pin.

With an inside admission direct and a transmission bar, both eccentrics lean toward the crank pin; while with the outside admission direct the eccentrics have the same position as with the inside admission indirect. With the inside admission indirect, the eccentric rods are crossed when the crank pin is on the forward dead center; the eccentric rods with the outside admission direct are also crossed when the crank pin is on the forward dead center.

93.—What effect would be produced on the lap and lead by changing the length of the eccentric rods?

A.—None. Changing length of eccentric rods is done only to equalize the lead at both ends. Lap cannot be changed.

94.—How can the lead of a link motion be changed?

A.—By moving the eccentrics.

95.—Why are eccentric rods made adjustable?

A.—To provide means for adjusting the movement of the valve so that it will produce the same amount of opening on each steam port.

96.—What is an Allen valve?

A.—A valve having an extra port that extends over the valve cavity from one side to the other.

97.—What is the purpose of the Allen valve?

A.—To increase the steam port opening so that steam may be admitted into the cylinder more rapidly than with the plain slide valve.

98.—Is the travel of the valve always of the same extent?

A.—No. The travel of the valve is regulated by the position of the reverse lever. When the reverse lever is set in full gear, the valve will travel its full stroke. As the reverse lever is notched back the extent of valve travel is gradually diminished.

99.—What effect on steam distribution results from shortening the travel of the valve?

A.—Its tendency is to accelerate the events of the piston stroke.

100.—What are the events of the stroke?

A.—Admission, cut off, release, compression.

101.—Describe these events.

A.—Admission is the act of steam entering the cylinder through the steam port opened by the valve. Cut off is the act due to the valve closing the port opening and preventing the admission of more steam. Release is the act of opening the exhaust port and permitting the steam to escape. Compression begins when the valve closes the admission port permitting the advancing piston to squeeze into small bulk any steam or air left in the cylinder.

Following these events of the piston stroke on a valve motion model is the proper way to understand them. Ten minutes' study with the aid of a model is worth a whole day's study without that graphic help.

102.—What is piston packing and where is it located?

A.—Piston packing is steam-tight rings placed in the grooves outside of the piston head.

103.—What is piston rod and valve stem packing?

A.—A piston rod packing consists of metallic rings and is located in the back cylinder head and encircles the piston rod making it steam tight. Valve stem packing performs similar functions for the valve stem.

104.—How are the metallic packing rings on piston rods and on valve stems usually held in place? What provision is made for the uneven movement of the rods?

A.—Metallic packing rings for rods are held in place by stiff spiral springs, pressing against a ring and forcing the packing into a bell-shaped cone.

Suitable provision is made for the uneven movement of the rods in the cone holding the metallic packing having a grooved steam-tight joint, which permits the cone to have a lateral motion against the face of the packing gland, thereby preventing the escape of steam.

Tempering Track Chisels.

Put the chisel in the forge and heat it. Then draw it out and finish it up just as you want it. Put it back into the forge and let it stay five minutes without blowing, until it has a cherry red heat. Then bring it out on your anvil and pour water on the anvil, and get a smooth-faced hammer. Strike lightly on the smooth side of the chisel until it quits frying water. Dress it off with a file two inches. Then put it back in the forge and heat it to a cherry red two and a half inches. Have some warm water and cool one and one-half inches. Wait until it becomes a light straw color and then cool one-half of an inch. Rub in the ground until it is bright and let it come to a bright blue, and cool off, you will find then that it will stand.

Changing the Lead.

In all indirect engines, that is engines having a rocker, to increase the lead, move the larger part of the eccentric toward the crank pin the amount of increase of lead required. To decrease the amount of lead, move the eccentric away from the crank pin the amount required. On engines with a direct motion, move the eccentric in the reverse direction.

Some Metals Need Oil, Some Do Not.

When drilling, reaming, rosebitting or tapping holes in wrought iron or steel always use oil or some other good lubricant. For cast-iron or brass do not use any kind of lubricant.

Lubricant for Oil Stones.

A good lubricant for oil stones is made by taking one part sperm oil and one part kerosene mixed, or if desired two parts kerosene may be mixed.

Reducing Friction in Threading.

When cutting threads on brass rods or pipes, the dies have a tendency to squeak. A solution of very strong soap suds applied to the metal will reduce the noise as well as the friction.

Babbitt Metal.

The composition of babbitt metal is a question about which there seems to be much confusion and diversity of practice; and the mechanic who undertakes to find out from the makers and users of the alloy just what it is composed of, and in what proportion, will probably receive many and diverse answers.

Many shops make their own babbitt, each one by a formula differing from most all the others; and in this way different specimens may be met with, varying from a mixture of eight parts of lead to one of antimony at one extreme, to one containing no lead and considerable copper and tin at the other. Even the manufacturers and dealers will offer for sale "babbit metal" in bars at prices ranging from 10 to 75 cents per pound; and they will insist that it is all "babbitt metal," only different qualities.

Now, if any one wishes to use as a lining for boxes an alloy which can be sold as low as 10 cents per pound, of course he should be granted the privilege; but when he calls the stuff babbitt metal he deceives himself or some one else.

We often hear the expression good babbitt, poor babbitt; but there is really but one babbitt metal, and if any alloy is either much better or much worse than that, it is not babbitt, but something else. Different authorities give various formulas for the composition of the metal, but the following is the real standard babbitt metal:

Melt separately 4 parts copper; 12 Banca tin, 8 regulus of antimony. After fusion, add 12 parts tin. The antimony should be mixed with the first portion of the tin, and the copper added after taking the melting-pot from the fire. The surface of the charge should be protected from oxidation by a covering of powdered charcoal.

This mixture constitutes the "hardening," and the babbitt metal is made by fusing one part of this hardening with two parts of tin, thus making the metal consist of 3.7 parts copper, 7.4 parts antimony, and 88.9 parts tin.

Blackening Steel.

Obtain a piece of an animal's horn, heat the steel or iron until it is hot enough to burn the horn. The metal need not be heated to redness. Rub the horn well over the metal, and while still hot rub any charred pieces of horn with a piece of oily waste, and a burnished black surface will result.

Cooling Drills.

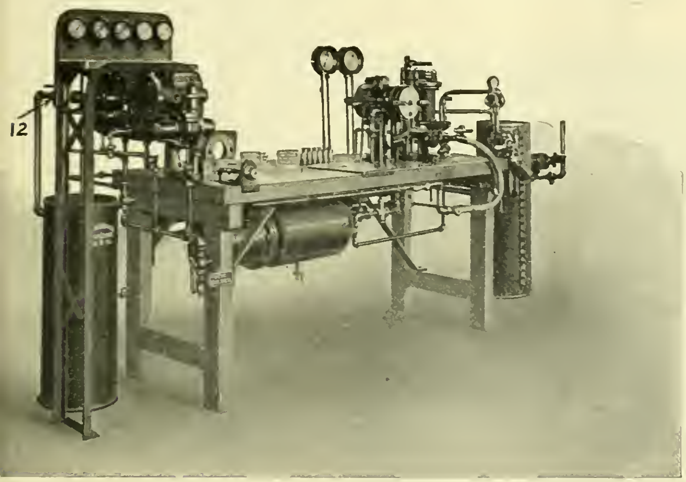
Where oil will not act as a cooling lubricant on a drill working in hard metals, turpentine used instead will induce the drill to take hold of the metal and retain its temper.

Air Brake Department

Combined Test Rack.

The photographic view is of the combined triple valve and distributing valve test rack, manufactured by the Westinghouse Air Brake Company.

The code of tests and explanations as to the manner in which they are conducted, as well as a description of the general operation, accompanies the rack, or will be furnished upon application to the company.



COMBINED TESTING RACK.

Stopping Freight Trains with the Air Brake.

Correct methods of stopping freight trains with the air brake have always been governed to a great extent by local conditions, and but a very few fixed rules or recommendations are ever attempted, as it is well known that instructions relative to train handling must either be confined to some local condition in order to be explicit or else must deal with average or general conditions.

The particular reason for this is that successful manipulation of the brake valve in handling various make up of long freight trains is the result of practical experience and good judgment as well as a knowledge of kind of equipment used and the distribution of loads in the train, and train handling cannot be learned by words of instruction alone. It is also necessary to have a knowledge of the action of brakes under varying conditions of service, make up of train and efficiency of the brake itself, so that intelligence may be combined with practical experience, to the end that modern trains may be stopped without damage by the air brake.

Longer trains, heavier locomotives and improvements in brake apparatus are continually necessitating changes in brake manipulation and rendering obsolete the recommendations and instructions of a few years ago, with the result that one of the most difficult problems the air brake instructor and road foreman of engines have to deal with is the successful operation of brakes on long trains.

All air brake men are aware that the distribution of loads and empty cars in a train is in many instances primarily responsible for a parted train or damaged lading, but at the same time the train would not likely have parted had the brake not been applied, and it seems reasonable, then, that, if possible, some method of brake application that will not part any make up of train would be of advantage if it can be discovered.

As the make up of train is left to the judgment of the yard master the engineer has no course left open but to take it out of the yard and find a method of brake application that will not wreck the train regardless of its make up.

In order to better those conditions it is manifestly the air brake man's duty to discover the worst possible make up of train from the air brake point of view and then discover a method of brake application that will bring the train to a state of rest in a reasonable distance without doing any damage to it or its contents, and the writer is pleased to state that this has already been done and by means of dynamometer cars located in various portions of freight trains, with different conditions of make up, the shocks and effects produced by different methods of application have been recorded so that the conductors of tests are enabled to state what the worst possible make up of train really is and what is the best method of stopping it with the air brake.

We have, in previous issues, stated that the consensus of air brake men's opinions is that if a succesful method of handling the worst make up of train can be discovered the problem is practically solved, as that method would answer for braking any train in a satisfactory manner, and under more favorable conditions less accurate manipulation would be required.

So much damage has been done by unequal braking effect throughout the long train that operating officials were compelled to take notice of existing conditions with the result that air brake men now have a number of recommendations for handling trains of loads and empties mixed, which are applicable to almost any division of a railroad upon which exceptionally long trains can be hauled.

Dynamometer car records show that the worst shocks are produced by the ordinary methods of brake application when the train is composed of loads and empties with all the empties in the rear, and it is conceded that the worst make up of train would be to have 20 or 25 loads ahead with 35 or 40 empty cars on the rear. This is, of course, due to the fact that the higher percentage of braking power on the empty cars may under certain conditions stop the rear end of the train while the forward portion is still in motion, and as the result of such an occurrence depends upon speed, weight and condition of draft gear, suffice to say that the stopping of one portion of a train while another portion is still in motion is sometimes disastrous.

To make this somewhat clearer to the student, the brakes on a long train apply much quicker on the head end than on the rear end, thus tending to bunch the slack, then when considerable braking power is finally developed on the rear

cars the higher percentage of braking power will again run the slack out, and should the speed of the train be low a second or third reduction of brake pipe pressure might build up enough retarding effect to stop the rear end of the train while the loads kept the forward portion in motion.

One successful way to stop a train of this kind on a level track is to close the engine throttle and allow the train to drift to a standstill, which is, no doubt, the ideal stop from a damage to train point of view. The next best stop would likely be to close the engine throttle and gradually apply the independent or straight air brake, allowing the entire train to drift against the engine, and the stop may be completed with a low engine brake cylinder pressure and without any assistance from the train brakes.

If the train will stop of its own accord or with the engine brake without doing any damage it is obvious that the nearest approach to a stop, equally free from serious shock, by the train brakes would be to apply them with the lightest possible reduction in brake pipe pressure.

In such methods of stopping a train distance of length of stop must necessarily be of a secondary consideration because an accurate stop without damage cannot always be made with a long freight train; in fact, very accurate stops with long trains are inclined to be accidental or be assisted by the final movement of the brake valve being to emergency position, therefore the initial reduction should be made far enough away from the desired stopping point to insure that the initial reduction alone will stop the train before the allowable distance is traversed.

This means to cut off to take coal or water and sometimes means an additional walk of a few car lengths for the brakeman to open a switch, but it is a practice the wise engineer will follow regardless as to whether the company's rules to cut off for water are absolute.

During the past two years some extensive experiments were conducted on the D., L. & W. R. R. by Mr. P. J. Langan, and on the A., T. & S. F. by Mr. M. E Hamilton, of that road, and Mr F. B. Farmer, of the Westinghouse Air Brake Company, and at the 1911 convention of the Air Brake Association those gentlemen and the members agreed upon the following recommendations in reference to handling freight trains:

In stopping freight trains from ordinary speeds with the automatic brake, use one application but two reductions.

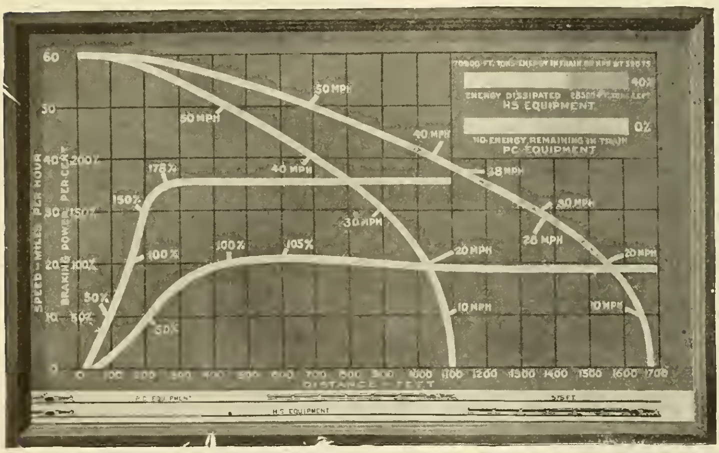
Make the first reduction sufficient and at a point to insure that it alone would, with no additional reduction, prevent the engine from passing the objective point.

Then, when within an engine length (not over 40 feet) of stop, make an additional reduction of 6 or 7 lbs.

The only object of this second and final reduction is to start the slack in at a time too late for it to run out again before the stop is contemplated.

It must not be made with the object of affecting the stopping point, for if made much earlier it is liable to cause rather than avoid a break-in-two.

The amount of the initial reduction, which must not be less than 7 lbs., should suit the speed of the train and should never exceed 12 lbs.



COMPARATIVE TRAIN STOPS WITH CONTROL VALVE AND HIGH-SPEED EQUIPMENTS.

Speaking generally and within the minimum limit stated, the less used the better will be the results.

For speeds of 15 miles per hour or less, use 7 or 8 lbs.

Above 15 miles per hour, use as much less than 12 lbs. as conditions will warrant and do not exceed this limit for ordinary, service braking.

The high brake shoe friction at low speeds will often cause serious shocks if the reduction is heavier.

At higher speed the brake shoe friction, the actual holding power where the wheels do not slide, is poorer for the same shoe pressure. Therefore, as slack action when applying brakes cannot be prevented, and it is less harsh with higher speeds, the object sought is to allow the slack to adjust itself gently, following the initial reduction at the maximum speed, and then not disturb it by a further reduction until the second and final one can be made to ease any strain on draft rigging and bunch the slack for the start, yet too late for it to run out again, as the brake valve will, if instructions are observed, still be discharging when the engine stops.

It is further recommended that steam be used as far as possible in preventing the harsh running in or harsh running out of slack, and the heavier the locomotive and the longer the train the more care that must be exercised.

Stress is laid upon the fact that ample time must be allowed for any change to take place in the position of the train slack—that is, when slack starts to run out or in, sufficient time must be allowed for it to adjust itself before any further use of steam or air is attempted.

In reference to taking up train slack in starting it is advisable to take up only a foot or two or else the slack of the entire train.

"Spot" stops should never be attempted, as the main object should be to stop properly within any reasonable distance.

Steam should not be shut off suddenly after being heavily used, and time should be allowed for the engine to drift in the slack before the brake is used. An exception would be when backing a train at low speed, when steam should be used to the stop. Other exceptions may be found when stopping trains at low speeds, because in making stops from slow speeds it is often advantageous to continue the use of steam until the initial reduction ends, shutting off just as the brake valve discharge ceases.

This latter case would apply particularly where the final tendency is for the brakes to run the slack out, as with empties behind loads.

The above recommendations pertain-

ing to the air brake handling of the train are but a part of the subject of break-in-two of trains, as draft rigging, brake and hose inspection and defective apparatus was also considered.

The New York "L. T." Equipment.

In this isue we present a piping diagram of the New York Air Brake Company's "L. T." (locomotive and tender) brake. This is a new and improved locomotive brake, furnishing all the features of the combined automatic and straight air brake and some additional features that are now essential to an efficient locomotive brake.

The apparatus is adaptable to all types of locomotives in either freight or passenger service.

The operation of the brake is similar to that of former equipments, but with the "L. T." the engine brake can be applied and released any number of times regardless of the train brakes and without disturbing them whether they happen to be applied or released.

It naturally follows that the engine brakes can be held applied while the train brakes are released, or the engine brake can be released while the train brakes are held applied.

The brake can be applied lightly or with full effect instantly, and the engine brake can be graduated on or off, and brake cylinder pressure is maintained at a predetermined figure against cylinder leakage or excessive piston travel.

The automatic brake and the straight air are separately maintained, a double check valve being located in the brake cylinder pipe between the straight air valve and the automatic control valve.

The names of the principal parts are shown on the diagram and it will be unnecessary, at this time, to mention every single detail as a brief description should render obvious the functions of many of the parts. The automatic brake valve is of the rotary valve and equalizing discharge valve type and has six positions, namely, release, running, driver brake holding, lap, service and emergency.

The straight air valve has five positions—automatic brake release, straight air brake release, lap, service and emergency.

The control valve operates through variations in brake pipe pressure which actuate a piston and slide valve similar to a triple valve, which in turn operates an application portion, but air pressure enters the brake cylinders directly from the main reservoir.

Two pressure controllers reduce main reservoir pressure to the desired pressure for the brake pipe and the straight brake valve and a movement of the straight air brake valve to automatic release position releases the locomotive brake independent of the train brakes or a succession of movements graduates the locomotive brakes off to any extent desired.

Release position of the automatic brake valve is used for releasing the train brakes, running position when going along the road and for releasing the engine brake, holding position is used for holding the engine brake applied while the brake pipe pressure is being maintained by the controller.

Lap position is to be used for holding train brakes applied—and for no other purpose—the use of service and emergency position are obvious.

The straight air brake is intended for handling the locomotive, and is convenient for alternating train and engine brakes on descending grades. When not in use the straight air brake valve remains in straight air brake release position.

The operation of the various valves will be explained in future issues and the flow of air from the pump is as follows:

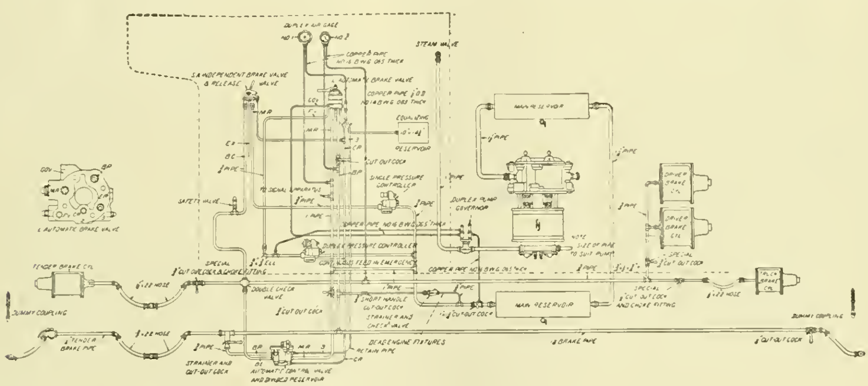
The pump compresses air into the main reservoir until stopped by the governor and from the main reservoir air flows direct to the automatic brake valve, the automatic control valve, the duplex pressure controller, the single pressure controller, to the air gauge, the maximum pump governor top, to the check valve of the dead engine fixture and, if in any of the first three positions, through the automatic brake valve to the excess pressure governor top.

With the automatic brake valve in release position main reservoir pressure passes through the rotary valve into the brake pipe and equalizing reservoir, through the actuating portion and into the auxiliary reservoir of the control valve and all brake pipe portions are charged to main reservoir pressure, but if the brake valve handle is in running position main reservoir pressure cannot pass the rotary valve and the brake pipe is supplied from the feed valve pipe which is maintained by the pressure controller.

The feed valve pipe is also connected with the excess pressure top of the pump governor.

The single pressure controller supplies the straight air brake valve, the controller being set at 40 lbs.

The automatic brake valve has the usual features of controlling the flow of air from the main reservoir to the brake pipe for releasing and charging the train brake and from the brake pipe to the atmosphere for applying the brakes, and in addition the brake valve acts as a retaining valve to the auto-



NEW YORK AIR BRAKE COMPANY'S "L. T." PIPING DIAGRAM.

matic control valve and maintains a continuous feed to the control valve when in emergency position.

The manner in which the above is accomplished will be explained when the various parts of the equipment and the results of possible defects are being considered.

Correct Use of Pump Governor.

The constantly increasing use of compressed air on modern locomotives has been met by increasing the size of the air compressors or air pumps and by using two pumps per locomotive, but it is obvious that when two pumps are applied to the locomotive an ample steam supply and ample exhaust outlet must be provided if the maximum capacity of the compressors is desired.

If either the piping, the governor or the steam valve is too small, especially with two compressors per locomotive, involving a main supply pipe with branches to each compressor, compressor capacity will be materially reduced and the railroad company does not secure all the benefit possible from its investment in the compressors; therefore the Westinghouse Air Brake Company has conducted an exhaustive series of tests in which the correct size of parts for different installation of compressors has been determined.

The accompanying table shows correct size of governor, steam valve and piping arrangement, and it will be observed that the 1½-inch governor is for use with two 11-inch or two 8½-inch compressors, while the 1¼-inch governor is for use when two 9½-inch compressors are used.

Compressor.		Steam Valve. Size.	Governor. Size.	Steam Supply Pipe—Size.	
No.	Size.			Main Pipe.	Branch to Each Compressor.
1	9½ in.	1 in.	1 in.	1 in.	......
2	9½ in.	1¼ in.	1¼ in.	1¼ in.	1 in.
1	11 in.	1¼ in.	1¼ in.	1¼ in.	......
2	11 in.	1½ in.	1½ in.	1½ in.	1¼ in.
1	8½ in. C.C.	1¼ in.	1¼ in.	1¼ in.	......
2	8½ in. C.C.	1½ in.	1½ in.	1½ in.	1¼ in.

Questions Answered

On Air Brake Subjects.

SAFETY-VALVE ADJUSTMENT.

126. G. N., St. Louis, writes: Is not the safety valve adjustment of 68 lbs. for the No. 6 E. T. equipment too high for the slow speeds in freight service; that is, is it not liable to cause wheel sliding? A.—We have on several different occasions attempted to explain just why the E. 6 safety was adjusted for 68 lbs. and why the leverage ratio on the engine with the No. 6 brake was arranged to develop less brake shoe pressure from a 50-lb. brake cylinder pressure than an engine equipped with the A1 type of brake. But leaving any comparison of brakes out of the question you will readily note that a 20-lb. reduction from a 70-lb. brake pipe pressure results in an equalization of pressure and application chamber pressures at 50 lbs., which means a 50-lb. brake cylinder pressure, which cannot be increased by any further reduction of brake pipe pressure, and cannot be affected by the safety valve whether it is adjusted for 50, 68 or 100 lbs. In cases of emergency a higher braking effect is obtained with the E. T. brake, and at such times the driving wheels should be watched and immediately released by means of the independent brake valve and re-applied, if necessary, should wheel sliding occur.

WRONG PUMP GOVERNOR.

127. W. C. S., Wheeling, W. Va., writes: I have noticed two 11-inch air pumps on a locomotive and controlled with a 1-inch governor. Is not this governor too small for use with two 11-inch pumps? A.—Yes. The proper size of governor for use with two 11-inch or two 8½-inch C. C. compressors is the 1½-inch. The 1-inch governor is for use with the 9½-inch air pump and the 1¼-inch governor is for use with one 11-inch, one 8½-inch C. C. or two 9½-inch pumps.

"BLOW FROM TRIPLE VALVE."

128. J. S., DuBois, Pa., writes: There was a blow from the retaining valve of a K 2 triple valve. The cut-out cock was closed and the brake applied. Cock was again opened and quick action on the train followed. What caused this? A.—The blow from the retaining valve was no doubt due to leakage past the emergency valve seat of the triple valve, and as the cut-out cock was closed the prompt escape of the brake pipe pressure caused the triple valve to move to application position, and the auxiliary reservoir pressure also lowered by expanding into the brake cylinder. Consequently, when the cut-out cock was again opened, the rush of brake pipe air into this depleted pressure caused quick action to take place. Quick action would not have occurred had the cock been opened very slowly. But after the cut-out cock was closed the auxiliary reservoir should have been bled to release the brake.

DEFECTIVE E. T. BRAKE.

129. J. S. DuBois, writes: (1) An engine with the E. T. brake was coupled to 30 cars, and both hands of the gauge showed 90 lbs. What causes this? (2) What are the causes of an E. T. brake applying when the handle of the automatic valve is in full release position? A.—(1) Assuming that the brake valve is in running position and that the air gauge is correct, the feed valve must be improperly adjusted or out of order, and the maximum pressure head of the pump governor must be set at 90 lbs. If the brake valve handle is in release position 90 lbs. pressure in both the main reservoir and brake pipe is correct. (2) With the handle of the automatic brake valve in release position, the exhaust port of the application cylinder of the distributing valve is closed, and any leakage into the application cylinder or its pipe connections would build up pressure and apply the brake. Leakage of this kind is usually from the equalizing slide valve of the distributing valve or from the rotary valve seat of one of the brake valves, but it could be from the brake valve pipe bracket gaskets or from the automatic brake valve body gasket. It is not necessary to have any leakage from the parts mentioned to cause the brake to apply when the valve handle is in release position, as the warning port then creates a leak in the brake system, and if the pump governor is not in perfect condition a fluctuation in pressure will occur, and if it is over 2 or 3 lbs. the equalizing slide valve may move to application position.

COMPRESSION OF PACKING SPRINGS.

130. (2). What is the practice in fitting piston rod and valve rod packing regarding compression left on springs? My contention is that compression to the extent of 1½ ins. on piston rod and 1 in. on valve rod is excessive and increases load on above named rods, thereby absorbing more than 10 per cent., which is usually allowed for overcoming engine resistance. I also contend that compression should be of such amount that it will bring packing rings to bear easily on rods, thereby decreasing load on same. A.—There is no hard and fast rule in regard to the amount of compression on metallic or other packing, the adjustment depending on observation and experience. A continued escaping of steam through the packing will readily show that the packing is too loose, whereas packing that is too tight will have the effect of bluing and carbonizing the rod. The proper point of tension therefore is at the point where leaking ceases. With a certain depth of stuffing box and certain size of rod and regular pressure, the amount of compression will readily become known to the experienced engineer or mechanic, but no table of relative amounts of compression has, to our knowledge, been established.

The Illinois Central has in addition to ordering 40 Mikado locomotives from the Baldwin Locomotive Works also ordered 10 Pacific type locomotives from the American Locomotive Company.

General Foremen's Department

Booming the General Foreman's Association.

The International Railway General Foreman's Association is a very useful organization and one that ought to be recognized by all officials of the railway mechanical department, because any training or information that will increase the efficiency of a general foreman will help to reduce the operating expenses of the company. The hints that a general foreman is likely to receive at an annual convention are likely to give him new ideas about shop management that will pay the company tenfold for any expense incurred in sending him to the convention.

The following remarks made by President Ogden at the last General Foreman's Convention, and others by President-elect Pickard are worthy of serious attention by the members. President Ogden said:

"I wish to impress upon your minds that you need to get busy and make your business to get all the members you can. I received several letters from men who did not know there was such an organization until they saw mention of it in RAILWAY AND LOCOMOTIVE ENGINEERING. They wanted to know how to become a member. This condition of affairs ought not to exist. Every general foreman ought to belong to the association; it is the duty of the president, the secretary and the executive board to get them on our list of members."

President Pickard said: "As your incoming president, there are several matters that pass through my mind. The first essential matter with a man is to get him to think, and, being successful in that, you have got a winner. As far as I am concerned personally I do not care if there are only twenty-five members up here if they are workers. We can have membership of 200, but if they do any more than some of you fellows who are sitting around here, I do not want you. You are not any good to your company; you are not any good to this organization, and you are not any good to further your personal interest nor that of your company by coming here.

"What did I come for? I came to gain knowledge from men who have some kink or method whereby I may be benefited. There are a great many fellows who have a lot under their hats, if they would only let it out. Get it into the proceedings so that you can profit by it next year. In my researches in connection with your association in the last year, you would be surprised if the letters were made public that I have in possession from your superintendents of motive power, giving their views upon the work of this association. One said: What is the use of my sending my man down there. He had a very elaborate expense account when he came back and that was all he had. I do not see his name in the proceedings.' We do not want that fellow. We want the man who will come down here and have the knowledge and the faculty of imparting it to the convention.

"There are going to be several committees appointed in our work next year, and it is going to be divided among a great number, so that the load will not be resting upon one, two or three, as it was in the past year. Last year we sent out 162 letters and got replies to four of them. If you are going to make your deductions from that, you would be like a bunch of dead ones. If I can take the position of that little bumble bee that we heard about last night, I am going to do a little bit of buzzing right down the line, and when that fellow hangs back a little I am not only going to stop, but I am going to sit down.

"I want to congratulate the presiding officers. They have done remarkably well. A word to the incoming officers: If you want to hold your job you have got to work, or you are going to get fired.

"In conclusion I wish to announce that at 9:30 tomorrow morning I desire to call a meeting of all the incoming officers and executive committee in this room, and I would like to have you all present.

"Another work in behalf of our friends who have so materially assisted us in this great work are the magazines and the able representatives that we have had with us."

Advantage of Attending Conventions.

When the "advantage of attending the convention" was under discussion at the General Foremen's Convention, one of the speakers remarked that he had the details of his shop management so organized that work went on as smoothly when he was away as it did when he was on hand. That represented a very satisfactory condition, it reflected credit upon the speaker, and testified that he is a profitable man to the people who employ him. Unfortunately a well organized system of carrying on railway machinery repair work is seldom properly appreciated by the higher officials. It is a melancholy fact that the fussy man, who talks loud and thinks that no job can be properly finished without his personal interference, is generally more popular with the heads of departments than the man of sound executive ability who organizes a system so that it moves like a well lubricated automatic machine.

During many years of experience in visiting railway repair shops, the writer has met with sad illustrations of the head of the establishments managing by the rough, roaring personal method, receiving at the same time credit for being a splendid manager. We remember visiting railroad repair shops in a middle West city one time that remained long in our mind as a dreadful example. On calling at the office we were informed that the master mechanic was in the shop looking after things. From the erecting shop we were referred to the roundhouse, which was reached by climbing over heaps of scrap. An engine was found on the turntable track, with a crowd of workmen congregated about the front end. On asking where we could find the master mechanic, he was pointed out inside the smoke-box adjusting the draft appliances, while the workmen, who ought to have done the job, were busy looking on.

While walking about with this hustler later on, we mentioned the question, "Why don't you attend the master mechanics' conventions?" "Have you been around these shops and suppose that I could go away for ten days and let everything go to wreck and ruin? Why, sir," he exclaimed, "I have not been away from this shop but three days in fifteen years and that was on company's business."

"Go to the conventions, indeed," repeated Mr. Nemo two or three times, as if weighing and relishing the absurdity of the suggestion. Then as if roused to action, he jumped up and exclaimed, "Come, and I'll show you what I have got to do instead of going to your conventions."

Then he rushed me the second time through the shop and roundhouse and pointed out the miserable condition of many of the engines, and gave me the assurance that when other master mechanics were enjoying themselves at Atlantic City he would be doing all that mortal man could perform by personal help and supervision to get some of these engines hurried through the shop. From there he dragged me through the car shop, and pointed out sundry cars that were undergoing a renovating process, and informed

me of a formidable list of others which ought to go through a similar ordeal before the summer rush of business called everything that could turn a wheel into service. And after he had exhausted himself expatiating upon the difficulties of making performance keep pace with the demands of the repairing service, he triumphantly inquired, "Now, do you think it is likely that I shall go to the convention?" With due humility, I conscientiously answered, "No."

But as I walked leisurely through the shops and noticed that most of the tools were run far below the economical speed, and that the cuts taken off were mere scratches beside the cuts taken in shops that made no claim to being progressive, I could not help thinking that the company might not be the loser if the master mechanic took a couple of weeks annually to see the work going on in other shops. I also thought that if Mr. Nemo had been in the habit of annually talking over the business of managing the mechanical department of a railroad with other men engaged in the same occupation, he might have received suggestions and information which would have proved beneficial to himself and to the company he tries so zealously to serve. A natural result of this wider intercourse would have been the convincing of the man that he might safely and judiciously leave certain details of work to his subordinates. That would have given him time to attend to duties more important than that of draft appliance adjuster, of roundhouse foreman or of car inspector.

That experience might have widened Mr. Nemo, but it might have left him more hidebound in his own conceit, for he is a representative man of a rapid diminishing class, who take great credit to themselves for taking no holidays and for themselves attending to every detail of their business. That sort of egotism is very comforting to those who indulge in it; but in nearly every case it is expensive policy for the companies they serve. I have never yet found a master mechanic, a master car builder, or a general foreman so overwhelmed with business that he could not go away for a holiday but that mismanaged the company's business. It is the small calibre men whose business is too great for their grasp that cannot find time to attend conventions or railway club meetings. Instead of commending the zeal of such men the higher officials should analyze the cost of work supervised by such men, for it will generally prove higher than that of others who put executive ability into action instead of petty personal direction.

He who is false to present duty breaks a thread in the loom, and will see the defect when the weaving of a lifetime is unrolled.—*Examiner.*

The Roundhouse Foreman.

BY TIMOTHY PHENIX.

There is no position connected with the mechanical department of railroad operations that requires more tact, judgment and energy than that of roundhouse foreman on a large road, especially where the motive power is about half that required to move the freight and passenger trains over the road, and more so if the rule is, first in first out. I have often seen engineers and firemen waiting from one to five hours with dinner pails in hand for the first engine to come in, and, as is often the case, when they begin to come, they come in a string. The first duty of the engineer is to make out his report of repairs needed; somethin like this: "Eng. No. 20; R., packing down; R. B. D., spring broke; R. F. E., truck, box runs hot; R., injector don't more than half work, etc." This the roundhouse foreman scans, while the road foreman of engines stands at his elbow saying: "How soon can I have that engine? It is time she was down to the yard now. Train dispatcher is calling for engines."

Now, the roundhouse foreman is in a fix; he knows if the engine goes out, and she should break down on the road, the road foreman of engines or the train dispatcher will not be held accountable, but the M. M. will call him to an account as to why the work reported was not done. His standard should be, not to let any engine go out that he would not be willing to go on and run himself.

Taking this as his rule, now the ball goes on. He orders Smith and Jones to put a new spring in, and hurry up; and "Brush, you get some oil and waste and pack that truck box, and be lively." Brush starts off muttering something about "it's always lively"; about this time comes the engineer with something he forgot to put on the report, and the foreman of engines wants to know how soon he can have that engine. By this time two or three more engines have come in, with reports made out, and there is pulling on all sides; and, what, with steam pipes blowing, eccentrics running hot, feed pipes leaking, and a hundred other things, our foreman is almost wild; goes round to Smith and Jones and finds the holes in spring are too small for the hanger to go through, and the air is getting blue with the blessings on the springmaker; then the hydraulic jack gets stubborn, and there's lots of fun.

I tell you the position of roundhouse foreman, if he is a conscientious man, is not a bed of roses, as was told to men some years ago when assuming that position on a trunk line, often having six or seven sections to one train, and going through the repairs on over 400 engines every month. The constant worry and responsibility of a position like this is enough to turn a man's hair gray in a few years.

I desire to offer some few questions that may be of use to those in similar situations. In the first place, there must be a good gang of men, and the foreman has it in his power to make them good or bad. He must by his own push and "git," show them that he is the color bearer, and go ahead, speak words of cheer and encouragement to the men, and give them credit or praise for a good job. Again, he must know his men, and let the same man, or pair, do the same work. For instance, let two men put all the springs in and do all the smoke-box work; another gang do all work on passenger engines; another set out packing, file and line up brasses, crossheads, etc.; another do work on injectors, gauge cocks and oilers. By so doing each set can have the tools suited to their work; the spring gang must keep the jacks in order, have chains, blocks, etc., in their care; the men that pack the oil cellers to have a half barrel of waste and oil soaked ready for use and securely locked up.

When Mechanic Arts Were Despised.*

When one follows the slow development of the arts in Europe it is surprising that men ever learned to do things with their hands, considering the discouragements they received from people who considered that manual labor was vulgar, no matter to what end it might be applied.

The mechanic arts were kept alive during that benighted period called the Middle Ages by ecclesiastics and denizens of religious establishments, but after the reformation a race of snobs succeeded to the soul-saving business who regarded with the direst aversion all lines of human endeavor outside of learned professions.

That philosopher who has been rightly regarded as one of the greatest men Britain produced, the philosopher whose discoveries have been described as links connecting the mind of man with the spirit of God, was called by Dean Swift as "that fellow Newton over the way, a glass grinder and a maker of spectacles." The sublime conceptions of the author of the "Principia" were considered by the sanctimonious libertine Dean Swift to be common applications of vulgar mechanic skill.

True happiness, we are told, consists in getting out of one's self; but the point is not only to get out, you must stay out; and to stay out, you must have some absorbing errand.—*Henry James.*

Electrical Department

Development in Railway Apparatus During the Past Year.

During the past year considerable progress has been made in the development and improvement of electric railway apparatus. The increase in the number of applications of the single-phase system has been particularly noteworthy. The latest single-phase locomotive built by the Westinghouse Company is equipped with four driving axles, and has eight motors, there being two single-phase motors geared to a quill surrounding each axle. This arrangement, which at first appears more complicated, is in reality, a lighter, cheaper, and more simple construction than that involving four motors of the same total capacity.

Most of the troubles on pioneer single-phase railways were due to operation at abnormally high speeds, at speeds higher than those for which the equipments were designed. These high rates of speed were a surface at first, but were made possible because the line voltage was always good and because the transformers were usually supplied with overvoltage taps. Furthermore, the motors had very steep speed characteristics, which permitted them to reach a higher speed than would be possible with a direct-current motor with the same gear ratio. This source of trouble is now eliminated in Westinghouse equipments by the use of an overspeed relay, which is electrically operated, and is controlled by the current and voltage applied to the motor through the control circuit. When the speed of the motor reaches a certain predetermined limit, the control circuit is opened on the higher notches of the controller. This makes it impossible to operate the cars above the limit unless there is a long stretch of down-grade, which is unusual on interurban lines. In any event, excess speeds are possible only when there is no power on the motors. This method of protection might safely be applied to direct-current motors, since extremely high speeds are not only dangerous, but in nearly all cases are unnecessary. High speeds are a source of expense because of the extra energy consumption involved, as well as because of the increased wear and tear of equipment.

One of the improved devices designed by the Westinghouse Company for service on 1,500 volts, direct-current systems, is a special dynamotor. This drives the compressor by means of a friction clutch of the standard automobile type, which is automatically cut in or out when the air reaches certain pressure limits. The dynamotor for high voltage lines, as heretofore arranged, furnished power for the control and lights, but with the Westinghouse system it serves also to operate the compressor, eliminating the necessity of a separate motor therefor. The Westinghouse dynamotor is so arranged that it will operate at normal speed on either 600 or 1,200 volt lines. This allows the air compressor to perform its duty much more effectively than is possible where ordinary compressor motors are used which operate at normal speed on 1,200 volts and at half speed or less on 600 volts.

The use of forced ventilation to increase the capacities of railway motors has been thoroughly tried out by the Westinghouse Company on a large scale and it has been conclusively demonstrated that its use will enable a motor to operate at a much higher continuous rating than would otherwise be possible. One method of applying forced ventilation is unique. A small motor-driven blower, with a fan on each end of the armature shaft, is mounted underneath the truck holster. Each fan furnishes air to the one motor. The air is taken from some distance up the side of the car so as to avoid, so far as possible, the introduction into the motor of dust and dirt from the roadbed. Forced ventilation has been used quite commonly for some years by the Westinghouse Company for locomotive motors, but it is only recently that forced ventilation has been so widely applied to car motors.

The success of field control on locomotives has been so encouraging that the Westinghouse Company decided to apply it for the control of the ordinary street car motors, for both slow-speed city and high speed interurban service. The advantage of Westinghouse field control in interurban service is largely due to the fact that the cars may be started with much smaller accelerating currents, and that they are therefore better adapted for local service. Yet it is possible by means of the field control to operate the local cars in limited service at high speeds. Ordinarily, where direct-current cars are used interchangeably in local and limited service, either one or the other class of service must, necessarily, be somewhat slighted, or the equipments would be badly overworked. Through the use of field control this contingency is avoided. Heretofore the same car could not be operated successfully in both local and limited service as two different gear ratios were required. With field control different gear ratios are not necessary since the operation with the normal field permits the motors to run the cars at slow speeds in city streets and also to run them at speeds necessary for first-class, interurban, limited service. This system of field control may be used with either the multiple unit or hand control.

Marked progress has been made in the application of multiple unit control for the past year. The Westinghouse "HL" control has been well received since it meets the demand for a single effective control, that will replace the hand platform control without any material increase in either cost or weight. In many cases the weight with HL control is even less than with hand controllers.

Construction of A Modern Railway Motor.

Electric motors have been used for the last twenty years and since the first motors built along the present general lines, which were those built by Sprague for the Richmond road, there have been many great improvements, so that today the railway motor is as reliable as any other piece of apparatus. In our previous articles on the Development of the Electric Motor, we outlined the history and growth of the railway motor up to present practice, so that now we will consider the modern motor and go into details regarding its construction and operation.

The essential parts of a railway motor are the frame, the housings and armature bearings, the axle bearings, the poles, the armature, and the brush holders. We will consider each of these in the order named.

THE FRAME.

The frame as the word signifies, is the steel casting upon which the electrical and mechanical parts are built, of which there are two types, the "split" and the "solid" or "box" types. Figs. 1 and 2 show these two types, respectively, and are photographs of the standard Westinghouse motors. The design in the frame in no way changes the electrical characteristics, as it is possible to have the same motor as regards speed and torque on either the "split" or "box" frames. Each of the two types, however, has its advantages.

Take for instance the split type and referring to our illustration, Fig. 1, it is clearly shown that by dropping down the lower half of the frame, which can be done by removing the parting line bolts, or clamping bolts from holes (C) and allowing the lower half to swing on a hinge on the upper half that the motor can be inspected and the different parts re-

moved for repairs. The armature (A) does not drop with the lower half but remains fastened to the upper half. The armature shaft runs in the armature bearings (J), which are held in the housings (H) one at each end of the motor, the housings in turn being fastened to the upper half by the bolts (B), two to each housing. If the armature is damaged it is an easy matter to loosen up these housing bolts (B) and drop it into the pit. After the armature (A) is removed all of the field coils (F) and the interpole coils (I) can be removed from the motor for repairs, directly from the pit without jacking up the car at one end and running out the truck. The nature of the trouble may be so slight that it will not be necessary to remove the parts and the motor can be inspected and the slight repairs made from the pit. The advantages of this split frame are obvious for small city and cross-country or interurban railways, for it is possible to make repairs and turn the cars back into service quickly.

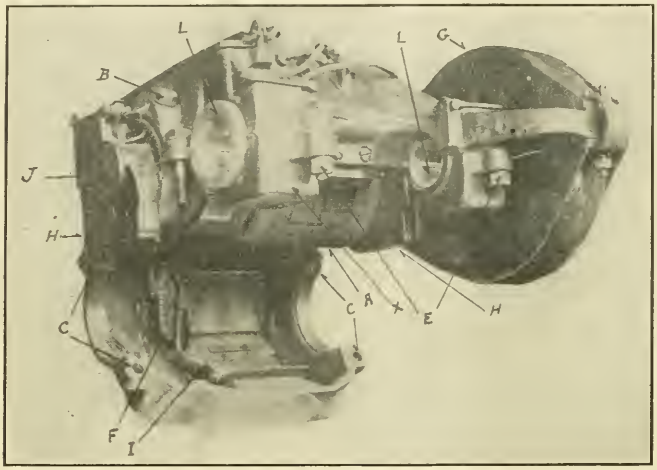


FIG. 1. SPLIT FRAME MOTOR.

With the box type of motor, Fig. 2, it is necessary to jack up one end of the car and run out the truck. The motor must then be removed from the truck and same repaired. On large railway systems this procedure is not a disadvantage as a spare truck fitted with motors can replace the one removed, or the damaged motor can quickly be replaced by an extra one and the car put back into service. The motor can then be overhauled and repaired.

This is done by loosening up the housing bolts (D), with the motor standing on end, removing the housing, which contains the armature bearing, as in the split frame motor, and then lifting out the armature, when it is possible to inspect and repair the field coils (F) and the interpole coils (I) and brushholders (K).

The box type motor has greater mechanical strength and as it is enclosed, dirt, moisture, etc., cannot easily penetrate to the windings. i. e., coils, etc. There is, of course, a limit in size to the split frame due to the weight and size of the parts where it would not be possible to repair them from the pit and it would be necessary to remove the truck if either type of frame was used. It is the general practice to use box frames for motors above 75 horsepower. Split frame motors need cause no trouble due to the lower half becoming loose, if large clamping bolts are used and the weight of the armature is carried by the upper half as is done in the Westinghouse motors.

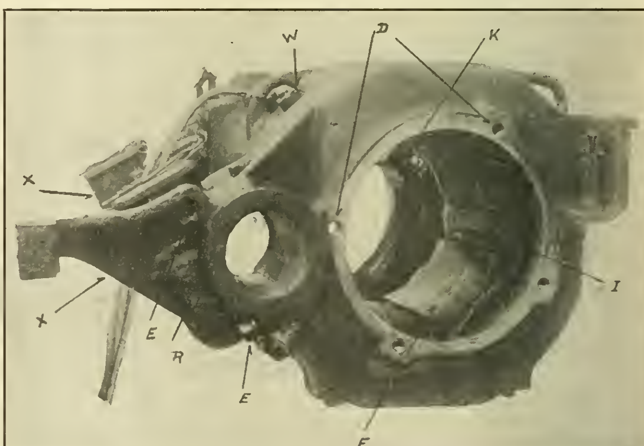


FIG. 2. BOX FRAME MOTOR.

Having outlined the two types of frames and the advantages of each, let us consider the manufacture, which is in general the same for both types. In the case of the split frame, both halves are milled or planed to a surface and most carefully done, so that the two halves will fit together closely, leaving no air gap through which dirt and water could get into the motor. Each half is carefully lined up before milling, so that just the right amount of material is removed in order that further operations will come correctly. After milling the halves are set up into another machine and holes are drilled to template for the clamping bolts (C) and axle cap bolts (E), Fig. 1. The first operation in case of the box frame is to locate the correct amount of material to mill off the frame at point (R) Fig. 2, and to set up the motor in the machine so that the slope of this surface will be exactly correct with respect to the vertical. The holes are then drilled for the axle cap bolts (E).

The halves are now bolted together, the axle caps (X), Figs. 1 and 2, are fitted in place, and the motor is set up in a boring mill to be bored out for the axle bearings (L), Fig. 1, and the armature housings (H). The ends of the castings are faced off to proper dimension between faces in this machine.

The next operation consists in boring out the inside diameter. This bore does not cut material from the whole inside surface of the casting, but only from the poles which project a few inches above the rest of the casting. To these poles are fastened the main pole pieces (P), Fig. 3, and interpole pieces (V), Fig. 4, by means of the stud bolts (S) passing through holes drilled to template in the frame and held tight by nuts and lockwashers (W), Fig. 2.

POLES.

The motor is now ready to assemble. The main field coils (M) and interpole coils (Z), each made up of copper strap of several turns, each turn insulated from

the other and all entirely covered by insulation, are slipped over the pole pieces (P and V) and the pole pieces bolted to the frame with a piece of spring steel (T) behind the coil and next to the frame to prevent all vibration and to take up for

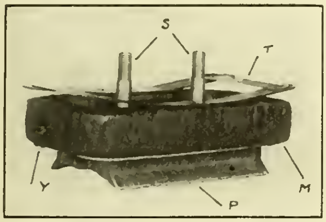


FIG. 3. MAIN FIELD POLE.

the shrinkage of the field coils. Electrical connections are made to the coils at terminals (Y) and the leads are pulled through holes, fitted with rubber bushings to protect the leads, in the frame. The main pole pieces are not solid, but are made up of laminations which are held between two end plates riveted together when the laminations are under a pressure of about 60 tons.

HOUSINGS.

The housings (H) are now fitted to the frame, the armature (A) put into place, the two halves bolted together and after the axle bearings (L) and gear case (G) are fitted the motor is ready for running after the bearings have been packed and oiled.

The lubrication of the armature and axle bearings is an important consideration, especially in case of the former, for if the armature bearing should over heat and the lining of babbit becomes melted, the distance which this would allow the armature to drop, would bring the armature into the pole pieces, as the air gap between the armature and the pole faces is small. It is the general practice to locate the armature center slightly above the center of the bore of the field poles, so that as the armature bearings wear the armature will have more distance to travel before striking on the pole pieces. The type of bearing used on the Westinghouse motors is an extremely satisfactory one and has given nothing but the best of service. Fig. 5 shows a cross section of one of these bearings and which constitutes the housing for the split frame motor.

The housing is provided with a separate oil pocket into which the oil is poured from time to time as needed and this pocket provides a means of gaging the amount of oil in the bearing, which should be kept at a level such that it will be carried up to the axle through the waste by capillary attraction. The oil is thus filtered before it reaches the axle and there is no dirt or grit which reaches the bearing. After the oil passes through the bearing and comes out at the back or inside end, it runs into openings in the housing, which drain into the overflow pocket from which it can be removed when the car is in for inspection and either used for outside oiling or cleaned and filtered and used again. The same arrangement is used on the axle bearings.

Coasting Clocks.

A saving in power consumption on a large electric railway where scores of cars are in operation not only means a saving in cost per car mile, but also means that a greater number of cars can be run without increasing the total amount of power from the main power house. It is an established fact that less power is consumed by the railway motors when the train is brought up quickly to a high speed and then allowed to coast instead of running at a slower speed using current, the same schedule speed being maintained in both cases.

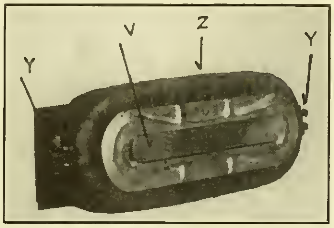


FIG. 4. INTERPOLE.

To accomplish this result the elevated railroads in New York and Chicago have installed in each car a coasting clock which, at the end of a run, by inserting a key, will stamp the amount of coasting which has been done. This clock is running at all times, but records are only made between the time that the current is shut off the motors and the time that brakes are applied and does not record the time during acceleration, braking or stopping at stations.

These clocks bring out competition between the motormen to run at the lowest power consumption and in this manner the results desired are obtained.

New Chemical Element.

Reports from Western Canada state that Mr. Andrew Gordon French, a native of Glasgow, and well known as a metallurgist, has discovered in the Nelson district of British Columbia an absolutely new element, which is expected to prove of high commercial value. The new element, it is added, has been named "Canadium" in honor of the Dominion. It is, Mr. French states, of the platinum group, and will probably fill one or other of the two vacant spaces among the noble metals in what chemists know as "the periodic table." These spaces are between osmium and tungsten and between ruthenium and molybdenum, and it is considered likely that "Canadium" will take its place between the second two.

"Canadium" is of a beautiful white color, and of brilliant lustre, apparently suitable for gem settings and similar purposes. It was found in the dyke rocks in the Nelson district, running in quantities from a few pennyweights up to three ounces to the ton. It occurs pure in semi-crystalline grains, and in short rods about half a millimeter in length by one-tenth of a millimeter in thickness. Mr. French also found it in metallic particles in the form of scales in platinum-bearing ores. These particles, which have a bluish-white color, contain the metal alloyed with a volatile substance which may be osmium, as it was dispelled by the blowpipe flame, leaving a brilliant bead of "Canadium." The new metal does not become tarnished by lengthened exposure to damp, and is not oxidized by continued heating in the blowpipe oxidizing flame. It is soluble in nitric and hydrochloric acid and in aqua regia without residue, and its solution in nitric acid yields no percipitate with chloride of sodium solution. This differentiates it from silver. It is not blackened by lengthened exposure to moist sulphuric hydrogen or to alkaline sulphides, tests which also prove that it is not silver. It is not blackened by tincture of iodine, and its nitrate solution is not precipitated by iodide of potassium. These negative qualities, Mr. French states, differentiate it from palladium.

Its melting point is somewhat lower than fine gold and silver, and very much lower than that of palladium. It is electro-negative to silver in dilute acid solution.

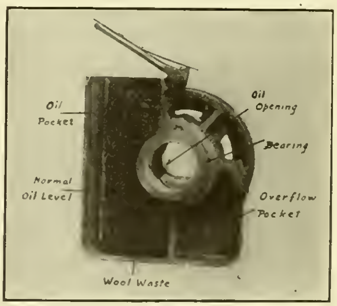


FIG. 5. ARMATURE BEARINGS.

These characteristics definitely show it to be a new metal of the palladium group.

The new element was found in a platinum mine previously discovered by Mr. French, and from which platinum, iridium, palladium, rhodium and osmium have been obtained.

Invention.

Believing that necessity is the mother of invention, we wish to devote enough space to quote five or six don'ts for air brake inventors taken from the third annual report of the Block Signal and Train Control Board of the Interstate Commerce Commission.

Altogether there are about 40 suggestions as to what not to do when the inventive idea suggests itself, and these should be carefully studied by any one who is contemplating an air brake invention. The readers of this department will appreciate the hard common sense ideas that are tersely expressed in the following:

Don't try inventing at all unless you can afford it as a hobby.

Don't forget that successful invention is not a pastime, nor a subliminal uprush, but an evolution from long experience, painstaking observation, careful analysis, intimate observation, with the varying requirements and local conditions in all parts of the country, thorough knowledge of mechanics and the laws of nature (not the least important of which are embodied in the M. C. B. rules of interchange and the rulings of the Interstate Commerce Commission), a severe disregard of non-essentials and of repeated failures and an unfailing persistence born of optimism, the courage of proven convictions and hard common sense.

Don't confuse invention and financiering. To invent is not synonymous with "to get rich quick." It is a simple matter of fact, familiar to any one acquainted with Patent Office records, that only a microscopic percentage of the patents granted bring any monetary return to the inventor.

Don't assume a parental attitude toward an invention. Fatherly sensitiveness and solicitude only add a sting to failure, while real merit will need only the backing of cold, hard facts to substantiate its claims.

Don't be satisfied with yourself or with your first or even your last idea of a device. Look for the defects, not the merits, in any design you propose to patent. The latter will always take care of themselves. An apparent success is, however, often more fatal than a flat failure. The latter at least tells the truth and usually teaches a valuable lesson; the former raises false hopes and obscures the truth and results in a correspondingly greater failure when the final reckoning does come.

Don't forget that there are always two sides to every question, especially in the case of a mechanical device. None are so bad as not to have some good points. On the other hand, the merits of a device may be many and important, and yet its patent value worthless on account of non-interchangeability, too great refinement, previous patents covering the same idea, and so on.

Don't expect something for nothing. Whenever such appears to be possible it will surely develop that the net gain is worth exactly the price paid, namely, nothing. Stored energy can be made to perform useful work only by a transformation from a higher to a lower level, by a progression from the concentrated to the diffused, never in the reverse order. The process of converting the energy in a pound of coal into available form as live steam is on a descending scale, never at 100 per cent. efficiency or anywhere near it. Again, the conversion of the energy of steam into available drawbar pull at the tender is attended by still further losses.

These examples are but typical of every process by which mechanical work is performed.

No mechanical system can be operated at 100 per cent. efficiency; at best it only approximates this figure under the most favorable conditions of the laboratory.

Don't mistake "possibility" for "practicability." Many things are possible, but only a few are practicable.

Don't forget that the millions of dollars of capital already invested in existing equipment prohibit the introduction of any device which will not work in perfect harmony with the apparatus now in use and under every conceivable condition of service.

Don't overlook the variability of the human equation. As long as there is any possibility of mishandling or wrong manipulation it will surely be found, for there are a thousand ways in which a thing may be wrongly done, but one right way. It is for this reason that "foolproofness" takes high rank in the prime essentials of all air brake devices.

Don't think that because an idea is new to you it is new to the air brake art. Thousands of dollars are spent in sifting out the old from the really new and patentable. If this is sound business policy for the large concern, with unlimited resources, how much more wise and prudent for the individual of limited means, who cannot afford to spend time and money without reasonable assurance of profit.

The conclusion of the many truths the inventor must learn either before or after the invention is that "inventing is an art of the highest type, requiring peculiar genius, training and experience, while the capacity for appreciating or foreseeing the real value of a patent is an entirely different thing, requiring quite a different sort of skill and education. Consequently even the best inventors are rarely, if ever, capable of accurately gauging the value of their own inventions from a purely patent standpoint.

The Cause of Iron Rust.

British investigators estimate that the rails of a single railway system in England lose 18 tons in weight every day, and that the larger part of this loss is due to the effects of rust. The problem of rust is of great economical importance, not only because of such losses as that just mentioned, but also because of such great expense involved in repainting iron and steel structures in order to preserve them. Thus $10,000 a year is spent in painting the great Scotch bridge over the Forth. Recent experiments indicate that pure iron in the presence of pure oxygen does not rust. It appears to be necessary for the production of rust that some acid, notably carbonic acid, shall be present. When iron is subjected to the action of water containing traces of acid, and in the presence of atmospheric oxygen, it always rusts. The rapid rusting of iron in railroad stations is ascribed to the presence of sulphuric acid derived from the smoke of locomotives.

Waterproofing Blue Prints.

Immerse in melted paraffin until saturated a number of pieces of an absorbent cloth, one foot or more square. When withdrawn and cooled they are ready for use at any time. To apply to a blue print, spread one of the saturated cloths on a smooth surface, place the dry print on it with a second waxed cloth on top, and iron with a moderately hot flat-iron. The paper immediately absorbs paraffin until saturated, and becomes translucent and completely waterproof.

A Smokeless Locomotive

A locomotive is said to have been in operation between Ostend and Brussels, in Belgium, for some time equipped with an aspirator which draws in the smoke and steam as given off, and carries it to a special receptacle, where they are chemically decomposed. Neither smoke nor steam reaches the atmosphere. There is no data given as to the amount of steam used in working the aspirator.

Cleaning and Oiling Belts.

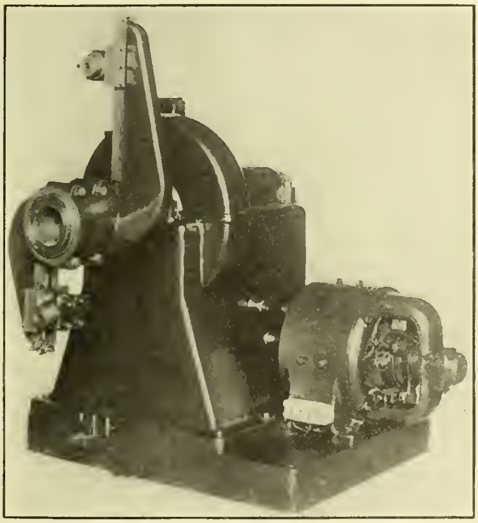
Belts which have become too greasy and dirty should be cleaned with gasoline, then scraped and afterwards wiped with waste. In dry, dirty places it is well to brush them occasionally with a broom or stiff brush. Fish oil and tallow are used successfully in some shops to prevent slipping, and it is good practice to apply these lubricants before using a new belt.

A New Facing and Boring Machine.

The accompanying illustrations shows a new type of facing and boring machine which has recently been placed on the market by the Rochester Boring Machine Company, Rochester, N. Y.

These machines are built for boring and facing combined or for facing only. The machine illustrated was built specially for double facing. The castings to be finished were faced inside and outside at the same time.

The two facing arms, it will be seen, are located in different planes and are of different lengths. The short arm is designed to reach into the casting and face the inside simultaneously with the long arm facing the outside. The surfaces to be machined are not continuous, which means an intermittent cutting, and it is particularly important that the surfaces are true, straight and with smooth finish. The rigidity of the machine and the strong section of the facing arm and construction in general have proven very satisfactory for doing the work required. The toolholder is arranged so as to be able to feed at right angle in either direction. Toolholder can also be swiveled to desired angle, being graduated to degrees indicating amount swiveled.



NEW FACING AND BORING TOOL.

The same principles of construction followed by the Rochester Boring Machine Company have been carried out on the general design of these machines, all gears and running parts being enclosed and fully protected. The worm and worm gear for the drive run in oil. Worm is made of nickel steel and hardened. Starting, stopping and changing of speeds are controlled with one lever located conveniently for the operator. By using a special variable speed motor and with the combination of mechanical speed changes provided with gearing in the machine a wide range of speeds is possible. The range of the machine illustrated is 8 to 1, the slowest speed being 1½ r. p. m., the fastest 12 r. p. m. The large arm will face up to 50 ins. diameter; the small up to 30 ins. diameter. The feed for facing is by star wheel. Machine and motor are mounted on a platen or base to make it self-contained and portable. It is arranged so as to be used in connection with another machine, being in this case a Rochester floor type horizontal boring machine. When in operating position it is located on the floor plate of the same and the two machines do work simultaneously on the same castings.

When machine is built both for boring and facing, spindle can be used up to 6 in. diameter for boring. The spindle has separate bearings in the housing and is driven by spline keys fitted into sleeve on which the main driving gear is mounted. Suitable feeds are provided for the spindle for boring. Spindle can also be quickly traversed longitudinally by a large hand wheel. Speeds and feeds can be arranged to suit any special requirements.

Cost of Rolling Stock Lubrication.

The Brandeis tribe of self-advertising agitators, who have done so much to spread unrest in the country during the last year, have characteristics of the kind described by an orator who remarked, "They resemble a type of man who habitually looks through the small end of a telescope and sees everything magnified. His eye perceives a small sage bush and magnifies it into a great apas tree spreading around its poisonous vapors that undermine the health of the people."

The business health of this community is improving, but no thanks to the agitation whose idiotic misrepresentations have deprived many people of their daily bread. One of the worst cases of attempted deception made by those people last year was the assertion that in the small item of lubricating oil alone our railroads waste two million dollars a year through Wall Street influence. "Wall Street influence" is the bogey of rogues who have no specific facts to present.

With all the long sustained howl about soulless corporations, it is undeniable that the householder purchases supplies cheaper under the control of corporations than they ever did from small dealers, and railroad companies have saved immense sums in the purchase of oil by their dealings with the Standard Oil Company.

The real story of the Standard Oil Company's connection with railway lubricating business is entirely different from what the agitators represented it to be, and the details will be remembered by many railway men still in harness. Hot boxes were the most annoying disorder of train operating that had to be contended with, and inferior lubricants was the cause. The remedy effected is given in the paper presented by Mr. Wilson E. Symons to the Franklin Institute, of which the following is a synopsis:

Some thirty years ago (1880), when there were in round numbers about 100,000 miles of railway in the United States, and the construction of new lines and other industrial development of the country in general were on a gigantic scale, those in charge of the work, especially railway construction and operation, could not give close attention to details. Certain others saw the need of improvement, and set to work in a systematic, business-like manner to bring it about, and to these pioneers properly belongs the title of *efficiency engineer* in its broadest sense, for the great financial benefits that have accrued to railway companies from the economies in operation which they made possible.

In the matter of lubrication, a superior quality of oil was produced, but like good clothing, food, fine horses, or other high-class commodities, it cost more than an inferior or poor grade; therefore, the railways would not at first consider its use, for the reason they did not see how any less quantity would serve their purpose, and at the increased price per gallon this would result in a big increase in cost of lubrication.

To meet this condition, the oil company offered to make the railroads safe against loss by a guarantee, on a mileage basis, staking their reputation and the difference in price, between a high-grade compounded oil and the cheap product then in use, against the results they felt sure could be obtained. The success of the plan proved the superiority of the good oil, and from this beginning the use of these oils was gradually adopted by most all lines, for in most every case there were the following good reasons for making the change:

First. A guaranteed reduction of 10 per cent. on existing costs per thousand-mile run.

Second. A guaranteed cost per thousand-mile run in future on all service.

Third. Responsibility for fluctuations in item of cost of lubrication on a mileage

basis, transferred from railroad to, and assumed by, the oil company.

All of which are excellent business reasons why any efficient railway manager would secure the higher grade and more efficient oils at a *higher initial* cost per gallon, but with a much *less net cost* for the *same unit* of service.

The result is, that at present, and for some years past, about 98 per cent. of the mileage and equipment is lubricated with the oils furnished by one company on the guaranteed mileage basis plan above mentioned, and in most every instance the change was made by virtue of the displaced oil company not being able to meet the 10 per cent. reduction offered, thereby losing out on a fair, square, competitive business proposition.

ECONOMIES EFFECTED BY OIL COMPANY.

When the oil company that now stands charged with coercing the railways into wasting two million dollars a year, through the purchase of their goods, first secured the business, it was, as previously stated, on a guaranteed reduction in cost per 1,000-mile run of 10 per cent., and protection against increased costs in future.

Since these oil contracts have been generally accepted by our railways, the trend of most all prices or cost of material and labor has been upward, except on two items, one of which the railways purchase and the other they sell, viz.: lubrication and transportation.

As locomotives have been more than doubled in size or capacity, and in many other ways require additional lubrication, and both passenger and freight cars have likewise increased in size, it is thought that a conservative estimate of the increased cost for lubrication, if left on the old basis of twenty years ago, would at present be about six dollars per 1,000 miles for locomotives, 60 cents per 1,000 miles for passenger cars and 30 cents per 1,000 miles for freight cars.

Mr. Symons then proceeds to present figures which show that our railways are saving over $10,000,000 annually through the economical practices maintained by the Galena Signal Oil Company in lubricating the railway rolling stock of this country. Yet Brandeis and the other sensation mongers make the assertion that the railway companies are wasting about $2,000,000 annually, by purchasing lubricating oil from people under Wall Street influence.

LUBRICATION—CONCLUSION.

In the matter of lubrication, the Galena Signal Oil Company has, by its efficiency engineering system of basing net costs on guaranteed service rendered, disregarding the purchase price per gallon of its high grade oils, succeeded, as previously stated, in securing about 98 per cent. of the business of our railways. And strange as it may seem, it is nevertheless true, that, although motive power and cars have, during the past twenty years, in most instances just about doubled in size or capacity, the oil company has constantly reduced the cost of lubrication per 1,000-mile run, and has therefore effected a double saving—one on the reduced cost per 1,000-mile run by cars and engines, and the other in providing lubrication for, and accepting as one unit, the thousands of new engines and cars that are twice the size of, and equal to two of, the type and size built some years ago.

From a review of the foregoing figures and facts, it should be clear to any unbiased mind that the actual saving to the railways, in money, on the single item of lubricating oil, based on cost of service rendered, is not less than an average of $5,000,000 per year for the past twenty years, and the additional saving, due to the increased size or capacity of engines and cars, together with the unestimated economies in various other items of a collateral character, resulting from the *"efficiency engineering system"* so successfully practiced by the Galena Signal Oil Company for the past twenty years, that it would be safely within the bounds of conservatism to place the actual amount saved at not less than $100,000,000 and that the present saving may be estimated at about $10,000,000 per year, which not only justifies classing General Charles Miller as one of the leading efficiency engineers, but discredits the statement that the oil company, of which he is the head, either uses coercion to secure contracts or overcharges for its oils $2,000,000 per year.

The Work Book.

Don't be anxious to put your name on the work book at the end of every trip.

It is not necessary, in order to be considered a good engineer, to display your knowledge of the various parts of your engine by covering a page with a long list of stuff about what is or is not the matter with your "right-go-ahead eccentric strap bolt nut," or the "cap to the left back journal box of the forward truck under tank." Of course, it is your duty to report all the work that is necessary, but be sure that you know just what is necessary before reporting any exact thing to be done to any part of your engine. Don't report a valve as "blowing" and needing to be faced, when perhaps the trouble is in the packing. Such a report entails several hours of unnecessary work, besides the shop wear of taking the valve out and repacking it again. This shop wear is frequently the source of more expense than all the wear and tear of the road. Perhaps a nut or two has to be split, a stud is broken or thread stripped, and a score of little hindrances that are quite likely to occur, as any machinist can testify.

Observe carefully the working of your engine, and report the repairs when you are certain they are needed. Leave a good deal to the judgment of the foreman or the machinist who is to do the work. Tell him the symptoms of the disorder rather than the exact disease.

Don't be too sure about the location of a pound. Nothing is harder to locate exactly. Don't give yourself away by reporting the side-rod brasses pounding, so as to break the glass in the cab windows, on the first trip after she is out of the shop and has had a new set of brasses all around.

Don't call the foreman out to watch the lost motion in the driving boxes and wedges, when he can't so much as see the grease wink while you thump her.

In short, remember that while it is true that "a stitch in time saves nine," it is frequently best to "let well enough alone."

There are two kinds of wear. One is that due to the natural friction of the parts as they work together; for instance, the brasses on their pins, cross-heads in their guides, piston rods, valves, packing, etc. The other is that due to a bolt or nut working loose, a frame working in a splice or joint, or brasses loose in their straps.

The first of these kinds of wear is expected and provided for in the design, and may go on for some time and to a considerable extent, without material injury to the working qualities of the engine. The second is not expected or provided for, and when discovered should receive prompt attention.

Do not allow bolts, nuts, keys or set screws to run loose. Here is where a "stitch in time" comes in good play. Do it yourself, and so save a charge against your engine.

A loose brass in a strap is many times worse than an eighth of an inch wear on the pin of a side rod.

Knives.

It is curious to notice the changes of spelling that lapse of time has given to many common things. Take knife, for instance. In Scotland, where Old English is spoken under the name of the Scots dialect, a knife is called a whittle, following with slight change Chaucer, who called it a thwytel. A noted Belgian cutler was Jacques di Liege, who made knives that were very popular in Scotland, and were called Joctelegs—a corruption of the maker's name.

Items of Personal Interest

Mr. A. LeMar has been appointed master mechanic of the Pennsylvania shops, with offices at Chicago, Ill.

Mr. L. Grimes has been appointed master mechanic of the Illinois Central, with office at Jackson, Tenn.

Mr. P. T. Dunn has been appointed master mechanic of the Pennsylvania, with office at Wellsville, Ohio.

Mr. J. W. Lowery has been appointed master mechanic of the Tombigbee Valley, with office at Valvert, Ala.

Mr. J. T. Lord has been appointed locomotive foreman of the Chicago Great Western at Minneapolis, Minn.

Mr. J. F. Sheehan has been appointed master mechanic of the Georgia & Florida, with office at Douglas, Ga.

Mr. I. Latham has been appointed master mechanic of the Nevada Copper Belt, with office at Mason, Nev.

Mr. T. R. Cook has been appointed assistant engineer of the Pennsylvania Lines West, with offices at Pittsburgh, Pa.

Mr. O. E. Berry has been appointed assistant master mechanic of the Lake Erie & Western, with office at Lima, Ohio.

Mr. C. H. Temple has been appointed superintendent of motive power of the Canadian Pacific, with office at Winnipeg, Man.

Mr. W. G. Lamb has been appointed master mechanic of the Waterloo, Cedar Falls & Northern, with office at Waterloo, Iowa.

Mr. E. H. Harlow, master mechanic of the Santa Fe at Richmond, Cal., has been appointed terminal master mechanic at Richmond.

Mr. W. C. Stone has been appointed foreman of the car department of the Missouri Pacific, with headquarters at De Soto, Mo.

Mr. F. J. Walsh has been appointed master mechanic of the Chesapeake & Ohio at Hinton, W. Va. He succeeds Mr. H. M. Brown.

Mr. A. B. Enbody has been appointed assistant master mechanic of the Central Railroad of New Jersey, with office at Mauch Chunk, Pa.

Mr. Samuel Higgins, manager of the New York, New Haven and Hartford, retired from the service of the company at the close of 1911.

Mr. C. C. Riley has been appointed assistant to Mr. A. W. Thompson, general manager of the Baltimore, Indiana & Ohio, with offices at Baltimore.

Mr. John Pullar, division foreman at Los Angeles, has been appointed master mechanic of the Valley division, of the Santa Fe, with office at Fresno, Cal.

Mr. J. R. Cameron, formerly general superintendent of the Canadian Northern, has been appointed assistant general manager, with offices at Winnipeg, Man.

Mr. D. H. Watson, general foreman of the locomotive department of the Baltimore & Ohio at Garrett, Ind., has been appointed shop superintendent at that point.

Mr. H. C. Needham and Mr. F. V. McDonnell have been appointed master mechanics of the Pennsylvania, the former at Richmond, Ind., and the latter at Logansport, Ind.

Mr. Walter W. Allen has been appointed enginehouse foreman on the Frisco at Chaffe, Mo., and Mr. F. G. McInteer has been appointed division foreman in the same road at Thayer, Mo.

Mr. J. F. Bowden, master mechanic of the Baltimore & Ohio at Garrett, Ind., has also, in addition to his duties as mechanic there, been placed in charge of the Chicago and Northwest divisions.

Mr. John H. Mason has been appointed road foreman of engines of the Lehigh Valley & Susquehanna division of the Central Railroad of New Jersey, with office at Mauch Chunk, Pa.

Mr. Gus Radetski, general superintendent of the Houston & Texas Central, the Houston East & West Texas, and the Houston & Shreveport, has been appointed assistant general manager of those lines.

Mr. D. J. Mullen, formerly master mechanic of the Cleveland, Cincinnati, Chicago & St. Louis at Mt. Carmel, Ill., has been appointed master mechanic of the St. Louis and Cairo divisions at Matton, Ill.

Mr. G. Y. Whitmee, foreman of water service of the Pere Marquette at Grand Rapids, Mich., has been placed in charge of water service on the entire Grand Rapids division, with office at Grand Rapids.

Mr. M. C. M. Hatch, chief draftsman of the Boston & Maine at Boston, Mass., has been appointed engineer of tests of the New York, New Haven & Hartford and the Boston & Maine, with offices at Boston.

Bruce W. Benedict, for several years in the motive power department of the Atchison, Topeka & Santa Fe Railway, has been appointed director of the shop laboratories in the department of mechanical engineering at the University of Illinois.

Mr. F. V. McDonnell, master mechanic of the Northwest system of the Pennsylvania at Mahoningtown, Pa., has been appointed master mechanic of the Southwest system, with office at Logansport, Ind.

Mr. N. J. Brooks has been appointed foreman of locomotive repairs at the Chicago & Alton, at Bloomington, Ill. He succeeds Mr. R. I. MacDonald, who has been appointed road foreman of engines at the same place.

Mr. T. Dunlop, mechanical superintendent of the Gulf, Colorado & Santa Fe, together with Mr. M. Robinson, master mechanic, have had their jurisdiction extended over the Pecos & Northern Texas, between mile post 461 and Coleman, Tex.

Mr. E. M. Hemphill has been appointed road foreman of engines of the Buffalo division of the Delaware & Lackawanna at Buffalo, in place of Mr. F. B. Evans, resigned. Mr. Hemphill is a locomotive engineer of wide experience, and a member of Div. 434, B. of L. E.

Mr. J. W. Small, superintendent of machinery of the Missouri Pacific at St. Louis, Mo., has been appointed superintendent of motive power of the Southern Pacific Lines in Texas, with office at Houston, Tex. Mr. Small succeeds Mr. J. J. Ryan, deceased.

President Flannery of the Flannery Bolt Company is a portly gentleman of fine presence, a characteristic which runs in the family. There are four brothers Flannery who aggregate an altitude of 24 ft. 8 ins., with a total weight over 1,000 lbs. Can any of our friends equal that as family dimensions?

Mr. W. W. Scott, formerly superintendent of shops of the Cincinnati, Hamilton and Dayton, at Morefield, Indianapolis, Ind., has been appointed shop superintendent of the Pere Marquette at Saginaw, Mich., in place of Mr. C. K. Woods, resigned. Mr. Scott was formerly connected with the Père Marquette at Grand Rapids, Mich.

Mr. S. B. Thompson has been appointed mechanical superintendent of the British Columbia Railway Company. This is a new office in the division of the company's work, its creation having been demanded by the great advance of its activities caused by the rapid development now going on all over the territory it serves. Mr. Thompson will have supervision of the company's rolling stock and electrical equipment at all points on the British Columbia coast and Vancouver

Island. He comes to Vancouver from New York City.

Mr. Jos. F. Gettrust has been appointed railroad representative of the Ashton Valve Co., Boston, Mass., assisting Mr. J. W. Motherwell, vice-president and manager of the department. Mr. Gettrust will devote his efforts particularly to the Southern railways, where he is well known, having represented the Galena Signal Oil Co. as mechanical inspector for many years on the railroads in that section.

Dieges & Clust, gold and silversmiths, 20 John street, New York, are giving away as a new year's gift a very convenient memorandum book, which contains much valuable information. Besides having the year's calendar, the small book contains a whole encyclopedia of useful information about postal matters, weights and measures, population of different places, and a whole host of things that people frequently wish to know about. Every person with this book in his pocket may consider himself rich in useful information.

Mr. John Howard, superintendent of motive power, New York Central Lines, announces the following appointments: Mr. C. H. Hogan is appointed assistant superintendent of motive power of the Eastern district (Hudson, Harlem, N. Y. & P., River, Mohawk and Adirondack Divisions) with headquarters at Albany Station. Mr. A. J. Fries is appointed assistant superintendent of motive power of the Western district (Buffalo, Rochester, Western Ontario, St. Lawrence and Pennsylvania Divisions) with headquarters at Depew, N. Y. Mr. L. H. Raymond is appointed superintendent of shops at West Albany, N. Y. Mr. H. Wanamaker is appointed superintendent of shops at Depew, N. Y. The positions of district superintendent of motive power, with headquarters at West Albany and Depew, N. Y., have been dicontinued.

Traveling Engineers' Report.

The report of the Nineteenth Annual Convention of the Traveling Engineers' Association just received, is certainly the most interesting report the organization has ever published, and reflects the highest credit upon Secretary Thompson for the painstaking work expended upon the volume and the handsome style in which it appears.

The Traveling Engineers' conventions have developed gradually, till now we consider them more valuable to the members and to the railway mechanical world generally than any other, and the report of the annual proceedings makes reading that will be preserved for the instruction it contains. This 1911 volume contains a great variety of excellent reading matter, that on Mechanical Stokers being the most exhaustive, forming the best treatise on the subject hitherto published. "Value of Actual Demonstration Compared with That of Oral Instruction in Air Brake Operation," forms a seasonable addition to air brake literature. That important subject, fuel economy, was represented by an excellent paper entitled "The Value of Practical Instruction on Fuel Economy," by Mr. V. C. Randolph of the Erie. The paper and the discussion that followed its presentation would make a very good pamphlet on firing.

Another excellent paper on "Mallett Compound Engine in Road Service," was presented by Mr. J. B. Dougherty, who gave to the convention much information on a subject that few enginemen are familiar with. We commend a careful study of this paper to people who are likely to have the care or handling of this form of locomotive, feeling certain that they will have their knowledge increased.

We reproduce the photograph of the past presidents and secretary.

Obituary.

JAMES BUCHANAN.

James Buchanan, for many years a master mechanic on the Lacakawanna, died very suddenly last month of heart disease while riding in a train. Mr. Buchanan was a brother of the late William Buchanan, long superintendent of motive power of the New York Central, and belonged to a race which have become prominent in the railway and engineering world.

OSWALD MORLEY LAING.

Mr. Oswald Morley Laing, superintendent of the Central New England, died on December 15, at Hartford, Conn. He commenced his career as a railway man as a clerk in the offices of the Chicago, Burlington & Northern, and was promoted to various positions in several of the western roads. He entered the services of the Central New England in 1906 as assistant superintendent, and was promoted to superintendent in 1909. He was in his fiftieth year. His death was caused by typhoid fever.

RICHARD N. DURBOROW.

We regret to note the death of Mr. Richard N. Durborow, general superintendent of motive power of the Pennsylvania Lines east of Pittsburgh, Pa. The sad event occurred at Philadelphia on December 9. Mr. Durborow was a graduate of the Maryland Military Institute and afterward served an apprenticeship in the West Philadelphia machine shops. He was some time in the mechanical engineer's department, and also occupied positions as inspector, foreman, master mechanic, and in 1901 he was appointed superintendent of motive power at Altoona, and latterly was appointed general superintendent of motive power. This death is much regretted.

PAST PRESIDENTS AND SECRETARY OF THE TRAVELING ENGINEERS' ASSOCIATION.
Top Row—J. D. Benjamin, J. A. Talty, P. H. Stack, W. G. Wallace; W. O. Thompson, Secretary; A. M. Bickel, D. R. MacBain, D. Meadows, A. L. Beardsley. *Lower Row*—C. F. Richardson, C. H. Hogan, C. B. Conger, F. C. Thayer, W. J. Hurley.

W. E. Sharp.

It is always gratifying to observe the advancement of railroad men to positions of large trust and responsibility, and among recent announcements we are pleased to observe the name of Mr. W. E. Sharp, who has assumed the duties of vice-president and general manager of the Grip Nut Company, Chicago, Ill. Twenty years ago Mr. Sharp was in the employ of the Erie Railroad as a laborer in the car shops at Huntington, Ind. Seven years afterward he was division general foreman of the locomotive and car departments. Then the Armour company induced him to accept the assistant superintendentship of the car lines. In 1900 he was advanced to shop superintendent, and latterly to general superintendent of shops, and his services as consulting engineer will still be continued with the Armour company.

W. E. SHARP.

Mr. Sharp has been a very active member of various railroad associations. He is a member of the Master Car Builders' Association, and has been particularly active in the work of that association. He took a leading part in the organization of the Car Foremen's Association, and as president of the Western Railroad Club his services have been highly appreciated. We join in our congratulations, both to Mr. Sharp and to the Grip Nut Company. He is the right man in the right place, and is another proof that you cannot keep an honest, active man at the bottom of the ladder.

Relics of James Watt.

A very interesting presentation was made last month at Manchester, England, when Mr. George Tangye presented to the Corporation a unique collection of relics of Watt, the inventor of the steam engine, Boulton, the partner of Watt, and Murdock, his ablest assistant. The collection consisted of a large number of mounted and unmounted drawings and letters dating from 1775 from the engineers named, as well as from many other leading men in the latter part of the eighteenth century. There were also a variety of models, including Watt's engine indicator, Murdock's rotary engine and pump, section of Newcomer engine, with several cases of drawing instruments. An interesting letter of Watt's addressed to the Abbé de Calonne, dated 1787, and in many ways is as applicable to events transpiring today as when written 124 years ago. Mr. Tangye also presented £250 towards the proper housing of the relics in a suitable room of the public library. The Lord Mayor presented a suitable resolution thanking Mr. Tangye for his generous gifts, and stated that the gifts were peculiarly gratifying to the citizens of Birmingham, where Boulton & Watt's works were located, and where the steam engine first came into practical utility. It will be recalled that Mr. Tangye is a member of the distinguished engineering family whose work, especially in hydrostatic machinery, made many advances in applied science. Among the earlier operations the launching of the *Great Eastern* was a notable work at the time. It became possible by a clever adaptation of the hydraulic jack, the invention of Richard Dudgeon, a Scottish mechanic, who became a very eminent American engineer..

Careful with Baggage.

Henry Clews, at a dinner in Newport, said of American traveling:

"It is delightful to travel in America, but I think that American porters handle our luggage a little too roughly.

"Once, at a certain station, I was amazed and pleased to hear a uniformed official shout to a burly porter:

"'Hi, what are you knockin' them trunks about like that for?'

"The porter had been lifting great trunks above his head and hurling them down onto the floor furiously; but now he stood stock-still in astonishment.

"'What's that, boss?' he said.

"'What do you mean by knockin' trunks about like that?' repeated the official. 'Look at the floor, man. Look at the dents you're makin' in the concrete. Don't you know you'll lose your job if you damage the company's property?'"

Forney Type of Locomotive.

The Forney type of locomotive remains a prime favorite in a wide range of service, particularly in suburban, logging, plantation and general industrial work. This type of locomotive came into popular favor in the installation of steam power on the New York elevated railroad. At one time over 400 locomotives of this type were in use in New York City, and were admirably adapted for the service.

The Vulcan Iron Works, Wilkesbarre, Pa., have earned an enviable reputation on the excellence of their work and material in this and other types of locomotives. During the somewhat depressed business period through which the country's industries have been passing, the company's shops at Wilkesbarre have been running to their full capacity. A large foreign trade has come to the enterprising company, and their fine products may now be found in many varieties of industries in almost every country of the world. In narrow gauge railroad work their locomotives have met with universal commendation, and a visit to the company's extensive works at Wilkesbarre, Pa., is a unique and interesting experience. Almost every kind of locomotive in use are in course of construction, but among the varieties the smaller types attract the most attention.

The accompanying illustration shows one of the Forney type, a number of which are in the service of the Norfolk Lumber Co. They are known as the Forney four-coupled type, and in point of simplicity and durability they are not surpassed by any locomotives adapted for the same service—their practicable speeds range from eight to fifteen miles per hour. They are wood burners, but the same type of locomotives are also being constructed to burn coal or oil as desired. For the classes of service for which they are adapted they will likely hold their place for many years to come.

The following are some of the dimensions of the largest type of the locomotive:

Cylinders, 10 ins. x 16 ins.

Diameter of driving wheels, 33 ins.; truck wheels, 18 ins.

Weight on driving wheels, 30,000 lbs.

Weight on truck wheels, 12,000 lbs.

Tractive force, 6,800 lbs.

Rigid wheel base, 5 ft.

Total wheel base, 15 ft., 11 ins.

Length over bumpers, 23 ft., 10 ins.

Height, 9 ft., 6 ins.; tank capacity, 700 gals; fuel capacity, 2,000 lbs.

New York Central announces that it has handed over control of the Rutland Railroad to the New Haven in part exchange for control of the New York, Ontario & Western. Permission has been asked from the Public Service Commission to complete the deal by purchasing for the Central treasury the Ontario & Western stock and stock of the New York & Harlem Railroad, which the Central has been operating under lease.

FORNEY TYPE OF LOCOMOTIVE.
Vulcan Iron Works, Wilkesbarre, Pa., Builders.

Car Shortage in Western Canada.

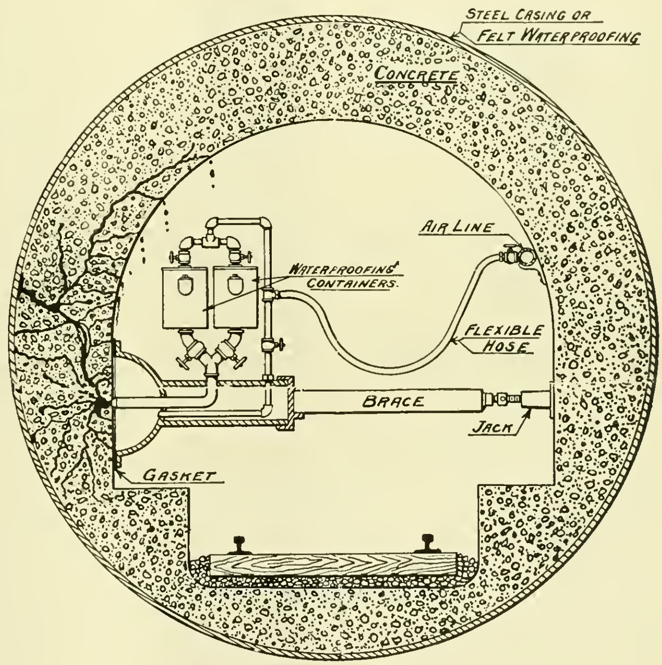
The railroads are handicapped because they find themselves absolutely unable to supply the demand for cars. This condition is the result, primarily, of the strike among the coal miners of western Canada early last spring. The cars that should have been used during the period that elapsed up to the grain-moving time were idle; and when the grain commenced to move, the cars were requisitioned for fuel and there was an immediate congestion of traffic. While the railroads have equaled and surpassed in some instances the amount of grain handled last year, they have not been able to accommodate the farmers during the past six weeks. This has resulted in much grain being sent to eastern Canadian ports through the United States, giving the American railroads the long haul, and has also operated to some extent in forcing the farmers to the American market, especially those who live along the international boundary.

The Moore Perfect Waterproofing.

After many unsuccessful attempts by the application of many ingenuous devices it is very gratifying to observe the complete success of the Moore waterproofing system for masonry. The reports from the Pennsylvania railroad and Hudson river tunnels attest the perfect efficiency of the products of the Moore Mica Paint Company in solving a problem that has baffled many eminent engineers. As is well known the vibration of heavy trains in tunnels has a tendency to produce cracks in the best kinds of cement work, and the inevitable leaking of water through the cracks were a source of repeated annoyance and expense frequently involving a complete stoppage of traffic while repairs were being effected. The worst feature of such repairs was the almost constantly recurring trouble, as surface cementing over such leaks proved invariably a temporary makeshift.

The accompanying illustration shows one of the new machines in position. The machine has been purposely enlarged in the drawing to show the details. Its purpose is to force the waterproofing compound into a porous concrete wall. The compound forces back and displaces the water and after completely filling up all crevices it solidifies and cements the mass together, not only completely closing the leakage, but greatly increases the strenth of the structure to which it is applied.

As will be observed, it may be readily applied to any position or to any point of the structure treated. The force of the compressed air projects the compound into the remotest parts of the crevices and is of such a nature that no lime or alkali has any effect on the hardened material. It may be stated that among the ingredients composing the compound fused mica forms an important part, which largely induces the formation of the substantial structure which in no single instance has been found to fall short in its desired effect.



MOORE WATERPROOFING APPLIANCE.

The Moore Mica Paint Company, 76 William street, New York, will gladly reply to any inquiries in regard to the application of their process to the work for which it is designed, and their reliability is guaranteed by the use of their products by many of the most eminent engineers in America.

We may love the mystical and talk much of the shadows, but when it comes to going out among them and laying hold of them with the hand of faith, we are not of the excursion.—*O. W. Holmes.*

Railroad Notes.

Ogden, Utah, may be made a terminal of the Western Pacific and become the eastern terminus of the road.

Grade separation, new shops and incidental improvements to be completed in three years at Spokane will cost the Northern Pacific $4,000,000.

It is believed that the Youngstown & Cleveland is to be an important link in the New York Central Lines with the intention of making Cleveland a distributing point for transatlantic and Panama Canal freight.

It is expected that early in January the double tracking of the Oregon Short Line, between Farmington and Ogden, Utah, 21 miles, will have been completed and the grade reduced from .78 of an inch to .05 inch, allowing heavier trains to be hauled.

The Missouri Pacific has arranged to raise $5,000,000 for payments on new equipment as follows: 65 locomotives, 50 cars for passenger equipment, 1 gasoline motor car and 5,000 freight cars.

It is estimated that rail orders for 1912 deliveries will amount to 500,000 tons. This would suggest that the roads intend to do some building and track improving the coming year.

The last rail has been laid on the Laramie, Hahn's Peak & Pacific main line from its connection with the Union Pacific at Laramie, Wyo., to the coal fields of northern Colorado. The road has been under construction 12 years through the backbone of the Rockies, and cost $4,500,000.

The double tracking of the Western Division from Poughkeepsie, N. Y., to Shelton, Conn., will be completed on or before the first of next June, according to the statement issued at the office of the New York, New Haven and Hartford Railroad Company.

The Western Steel and Foundry Company has received an order for 1,000 steel frame box cars, 80,000 pounds' capacity, from the Canadian Pacific Railway, delivery to be started January 1, 1912, and to be delivered at the rate of thirty cars a day. In addition to this order, the company has given out further contracts for 3,500 similar cars.

The Illinois Central has ordered 40 mikado locomotives from the Baldwin Locomotive Works and 10 Pacific type locomotives from the American Locomotive Company.

The Crooked River Bridge on the Oregon Trunk Railway, now nearing completion, will be one of the highest in the world. It consists of a steel arch 340 feet long, with floor 340 feet above the stream. The arch is being built on the contilever principle.

A contract providing for enough all-steel passenger cars to equip its main line trains has been signed by the Illinois Central Railroad Company. The contract calls for 1,115 cars and involves an expenditure of $1,500,000. It is expected that the first delivery of the new cars will be made about the first of the year. The plan is to equip every main line train on the system, both through and local, with steel cars.

The construction of the extension of the Quanah, Acme & Pacific Railroad from Paducah, Tex., to El Paso, via Roswell, N. M., a distance of about 500 miles, will soon be started. The survey for the line has already been made. This road is owned by the 'Frisco interests, and its completion to El Paso will give that system a direct line to the remote Southwest and the Pacific Coast in connection with the Southern Pacific and Santa Fe. It will also afford a new outlet for Northwestern Mexico, besides opening up for development a great scope of country in Texas and New Mexico that is now far removed from railroad transportation facilities.

The experience which the Lehigh Valley Railroad has had in using all-steel cars for its passenger service has proved so satisfactory that it will now put into service trains consisting of all-steel cars from end to end. The company has just awarded contracts for the construction of 25 steel cars, including 15 combination baggage and mail cars, 60 ft. long, and ten combination passenger and baggage cars have been ordered. Five of these ten, designed for long distance service, are to be 70 ft. long, with six-wheel trucks, while the other five will be 60 ft. long, with four-wheel trucks. The cars ordered are to be delivered in January.

Governor O'Neil of Mississippi has authorized the organization of the Gulf Port & Western, and development is to proceed promptly.

The new line is to run from Gulf Port, Miss., to Covington, La., through the counties of Harrison and Hancock to the Louisiana State line, where it will connect with the Hammond & Eastern, which is owned and operated by the Illinois Central and is hunting for business with the South and through the Panama Canal.

CATALOGUES AND BULLETINS.

Bordo Flexible Joints.

The success that has attended the operation of the Bordo flexible joints in use between engine and tender is such that the method was used in the construction of a Mallet compound locomotive, in service on the Santa Fe Railroad, and which was recently described in our pages. It will be recalled that the methods that are used on the flexible hose couplings were applied to the jointed boiler of the large locomotive enabling the boiler to adjust itself to every oscillation and curve incident to locomotive service. The success of the important experiment is reported to be of the most complete kind, and adds another marked success to the adaptability of the Bordo flexible joints to an important feature of large locomotive construction. Descriptive catalogues may be had on application to the L. J. Bordo Co., Philadelphia, Pa.

Baldwin Record.

The Baldwin Locomotive Works' Record No. 71 is just issued, and contains in elegant form and finish the descriptions and illustrations of fourteen types of locomotives recently built for industrial and contractors' service. These locomotives range from the smaller type of tank engine, with a weight of 11,700 lbs., having a tractive force of 1,600 lbs., to the larger class of six-wheel switchers, having a weight of 245,000 lbs., and a hauling capacity of 37,800 lbs. A peculiarity of nearly all of these locomotives is their adaptability to the sharpest kinds of curves, while their simple and substantial construction render them suitable for the roughest kinds of service. Copies of this interesting record may be had on application to the company's works at Philadelphia, Pa.

Dart Unions and Flanges.

The E. M. Dart Manufacturing Co., of Toronto, Ont., have issued an elegant folder showing in illustrated detail the various forms of construction of their malleable pipe ends with methods of attachment, including unions suitable for every variety of air pumps, elbows and flange unions adapted for high or low pressures. The designs are threaded or furnished with bolts and nuts as may be required. The Dart principle, established in their unions, whereby two bronze seats are used, has stood the test of fifteen years of successful use and the flexibility of the bronze joints are such that absolute tightness is assured in every case. The illustrations in the folder show in metallic coloring the convex and concave fitting of the male and female joints, and show the ease with which the joints may be replaced if necessary. A complete classification of sizes and price list accompanies the illustrations. Copies of this fine folder may be had on application to the company's offices at Toronto.

Abrasive Materials.

The Carborundum Company has been advised through the Department of the Interior at Washington that the Grand Prize for the exhibit of abrasive materials has been awarded by the Jury of Awards of the Turin Exposition to The Carborundum Company, Niagara Falls, N. Y. The great Italian Exposition was held from April 15 to October 31 of this year, and many American manufacturers were represented. The Carborundum exhibit showed a complete line of carborundum wheels, aloxite wheels, carborundum dental wheels, carborundum sharpening stones and razor hones of all descriptions. Such an award is a signal honor, and in addition to the distinction thus accorded to the Carborundum exhibit there was a widespread interest among the visitors to the exposition manifested in the wonderful abrasives, carborundum and aloxite.

Falls Hollow Staybolts.

The Falls Hollow Staybolt Co., of Cuyahoga Falls, Ohio, have been making marked progress during the year in the way of further additions to their extensive plant and have recently installed a number and variety of fine threading machines and are now fully equipped to manufacture individual stays in every size. As is well known, their improved method of rolling the centers of their hollow staybolts makes unfailing telltales on fractured or broken stays. The use of their hollow staybolts on locomotives is taken by the Federal boiler inspectors as proof without test against broken stays. A series of tests under varying conditions have also shown that the hollow rolled staybolt possesses double the endurance of those made from the best solid iron. It may be added that their methods of construction are also finding much favor with the users of mining drills and thawing points, and even the use of hollow shafting has demonstrated the great value of their products. Complete details may be had on application.

Rockford Planers.

The Rockford Planers are fully described and finely illustrated in a new bulletin issued by Joseph T. Ryerson & Son, Chicago, Ill. The planers embrace heavy-service planers, variable-speed planers and motor drive planers. Five different types of planers are described and illustrated, with added details of new devices in connection with the planers. These devices are all of marked value and contribute largely to the efficiency of these fine machines. Among these may be mentioned the micrometer adjustment, which is a great convenience for rapidly and accurately obtaining certain depths of cuts. The marked improvement in the product of high-speed steel in recent years has brought about many improvements in the mechanism of planing machines, and an experience extending beyond the middle of last century has given this enterprising firm the opportunity to keep in the fore front of machine makers. A complete catalogue of their high-class products is in course of preparation. Meanwhile a copy of the Bulletin on the Rockford Planers should be in the hands of all whose business necessitates the use of planing machines.

Chains.

One of the most interesting catalogues that have recently come to our notice is that of the Bridgeport Chain Co., of Bridgeport, Conn., and contains not only a list of the various chains made by that company, but some very interesting data on tensile strength, lengths, link construction, sizes, etc.

The line comprises light, intermediate and heavy chains of numerous types from light chains for indicators to heavy platform diameters.

We must not purchase chains "by guess"; we do not want to pay good money for a heavy chain when a lighter one will do; neither do we want to court a break-down by over-zealous saving in cost.

The Engineering Bureau of Railway and Locomotive Engineering considers this catalogue of the Bridgeport Chain Co. of sufficient merit to place in our reference file and the Bridgeport people will be glad to send a copy upon request to anyone interested in this class of material.

Constructive Railway Policies.

The Railway Business Association Bulletin No. 9 deals with the constructive railway policies of the past year, and it is very gratifying to learn from the able pen of Mr. George A. Post, president of the Railway Business Association, that out of the enormous mass of railroad legislation a digest is being kept by the Association of the legislative work of each State, bearing upon railroads, and that the attitude of all of the States will be fairly placed before the people in the form of an uncolored narrative. Hence these bulletins which are fulfilling their purpose with a degree of luminosity that leaves little to be desired. The Bulletin before us has the cheering intelligence that the legislative mind is evidently approaching nearer to sanity than might be expected. There are 58 per cent. fewer laws passed last year than in 1909, when the furore of railroad legislation seemed to possess the legislatures. At this rate the future is full of hope. Copies may be had from the secretary, Mr. F. W. Noxon, No. 2 Rector street, New York.

He that cannot reason is a fool; he that will not reason is a bigot; he that dare not reason is a slave.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXV. 114 Liberty Street, New York, February, 1912. No. 2

On the Grand Trunk Pacific.

The potential possibilities of railroad construction are nowhere being better exemplified at the beginning of the present year than on the Grand Trunk Pacific Railway. The road is now in full operation between Fort William, Ont., and Fitzhugh, Alta., a distance of 1,478 miles. Another portion, from Prince Rupert, B. C., easterly to Houston, B. C., 240 miles, in also in operation. On the Eastern division from Moncton, N. B., to Winnipeg, Man., a distance of 1,800 miles, the track is almost completed. The road will extend in a remarkably straight line from Halifax, Nova Scotia, to Prince Rupert, British Columbia. Important branches are also projected, the largest being that from the southeast portion of Saskatchewan to Port Churchill, on Hudson Bay, and another almost as long from a point near Prince Rupert on the Pacific Ocean to Dawson, in the Yukon region. There are a number of lesser branches already in operation, some reaching southward to the boundary line between the United States and Canada, and all of them opening up vast territories rich in agricultural and mineral wealth. When the main line is completed it will have the advantage of being the shortest route by several hundred miles of any now existing between Europe and the Orient.

A TUNNEL, A TRESTLE, AND A FILL ON THE GRAND TRUNK PACIFIC RAILWAY. LAKE SUPERIOR BRANCH.

A very low grade is being maintained

from coast to coast, the maximum gradient in feet per mile eastbound being 21, westward 26. The highest summit is 3,712 ft., at the Yellowhead Pass, Rocky Mountains. Our frontispiece illustration shows a tunnel, a fill, a trestle and a rock cut at a point on the line east of Winnipeg. The other illustration is a view of the highest bridge on the Grand Trunk Pacific Railway. The roadway of the bridge is 213 feet above the bed of the Pembina River and is 900 feet in length. This river runs in a northeasterly direction, and numerous seams of a good quality of lignite coal are being developed at several points along its banks. The track laying has been proceeded with at the rate of about three miles per day. The company are fortunate in the matter of timber as large portions of the country through which the line passes are thickly wooded, principally with spruce and jack-pine. All of the rivers and lakes are richly stocked with fish, Lake Wabamun in Alberta being perhaps the most remarkable lake in the world for its wonderful supply of white fish of the finest quality. Indeed the richness of the country, especially in the Northwest, in what may be called the newer portion of North America, is only beginning to be known. It was long looked upon as the region of eternal winter, but the railroad pioneer has dispelled all this and the locomotive proceeds, as it were, in a career of triumph, and wherever it goes the blossoms spring around. The wheat fields that have already been garnered along the line of the Grand Trunk Pacific are but the beginning of harvests that are beyond the dreams of the advanced guard of immigration that have settled in sections here and there. Towns are springing up all along the line, and the year that has begun is full of promise of a larger development than has ever before been seen in the Canadian Dominion. In addition to the 1,800 miles already in operation there are about 2,800 miles additional under construction, and by the time that these miles are traversed, the engineers, track-layers and spike-drivers will be following each other into new and undiscovered lands.

We expect to be able at an early date to present some particulars in regard to the repair shops under construction at various points on the new divisions of the Grand Trunk Pacific Railway.

BRIDGE OVER THE PEMBINA RIVER, GRAND TRUNK PACIFIC RAILWAY.

Heaviest Bridge Swing.

On the outskirts of Sacramento, Cal., the Southern Pacific is erecting a steel bridge across the Sacramento River that contains the heaviest swing span of any bridge in the world. It is 400 ft. long and weighs 6,300,000 lbs. The entire structure, however, will weigh more than 10,000,000 lbs. when in position upon the heavy concrete piers.

Only two steel bridges in the world have swing spans that exceed this one in length. One is across the Willamette River and is part of the Spokane, Portland & Seattle system. Its weight, however, is 5,400,000 lbs., 900,000 less than that of the Sacramento River bridge. The Omaha Terminal Co. operates a large steel bridge across the Missouri River that has a swing span 520 ft. long, but the steel is of much lighter construction, the weight being only 5,100,000 lbs.

The Sacramento River bridge is a part of the double tracking of the Harriman lines. It will contain not only two tracks for the trains but a concrete wagon and automobile road. The American Bridge Co., which is fabricating the steel work for the structure, has records of numerous heavy swing spans, but none that equal that of this Southern Pacific bridge.

Precious Iron.

When Captain Cook and the early navigators first sailed into the South Seas on their voyages of discovery, one of the things that struck them with most surprise was the avidity which the natives displayed for iron. Nothing would go down with the natives, says Cook, except metals, and iron was their favorite. A nail would bring a good-sized pig; and on one occasion the navigator bought some four hundred pounds of fish for a few wretched knives made out of an old hoop. Thus the early voyagers purchased the contempt of savages.

"For iron tools," says Captain Carteret, "we might have purchased everything upon the Freewill Islands that we could have brought away. A few pieces of old iron hoop presented to one of the natives threw him into an ecstasy little short of distraction."

Scientist in Error.

A German pretended scientist asserts that machinery tends to deaden men's higher instincts. That long familiarity with machinery makes men brutal and robs them of humane tendencies; that it deadens the nervous system and plays havoc with all emotions. We have known men who have handled that most exacting machine, a locomotive, for half a century, and they did not manifest any of the demoralizing tendencies discovered by that German. Some scientists are noted for discovering mares' nests.

Express Passenger Locomotive for the North Eastern Railway, England, Atlantic Type.

We reproduce an illustration of a new type of locomotive which the chief mechanical engineer for the above line, Mr. Vincent L. Raven, M. I. C. E., has designed, and has been built at the works of the North British Locomotive Co., Ltd., Glasgow, as these special engines were urgently required and the railway company's own shops were full up with other building. The engines in question have four wheels coupled, a leading truck and a pair of carrying wheels under the firebox. The coupled wheels are 6 ft. 10 in. in diameter, the truck wheels 3 ft. 7¼ in. in diameter, while the carrying wheels are 4 ft. in diameter. The cylinders are three in number and are all cast together, one central and two outside of frames, and are 15½ in. in diameter, with a stroke of 26 in., and are fitted with piston valves. Ten engines will be built with saturated steam and ten with superheated steam (Schmidt's system). The superheated engines will have cylinders 16½ in. in diameter; all other parts will be similar to the saturated steam engines. These engines will be the first passenger engines built for any English railway with three cylinders and piston valve chambers cast in one casting. They are built to deal with the heavy East Coast passenger traffic between York, Newcastle and Edinburgh. The principal dimensions of these fine engines are tabulated below:

Stroke of pistons, 26 ins.; length of ports, 1 ft. 4 ins.; width of port in liners, 1⅜ ins.; distance apart of outside cylinders, center to center, 6 ft. 2½ ins.; distance between outside valve spindles, center to center, 2 ft. 10½ ins.; lap of valves, 1⅜ ins.; maximum travel of valves, 4 19/32 ins. inside cylinder, 4 15/32 ins. outside; lead of valves, 1/16 in.

Driving and trailing coupled axles—Diameter of wheel seats, 9½ ins.; diameter of bearings, 9 ins.; diameter of bearings at center, 8½ ins.; length of bearings, 10 ins.; distance between center of bearings, 3 ft. 10 ins.; length of wheel seats, 7 7/16 ins.; diameter of wheel seats for carrying wheels, 8¾ ins.; diameter of bearings, 7 ins.; diameter of center, 6¾ ins.; length of bearings, 1 ft.; distance between center of bearings, 6 ft. 10 ins.; length of wheel seat, 7 9/16 ins.; depth below centre line of boiler, back end, 5 ft. 4 ins.; thickness of front end plate, ⅝ in.; thickness of back, end plate, ⅝ in.; thickness of sides and top plate, ⅝ in.; distance of copper stays apart, 4 ins.; diameter of copper stays, 1 in.

Inside firebox (copper)—Length at bottom inside, 8 ft. 3½ ins.; breadth at bottom inside, 3 ft. 2½ ins.; from top of box to inside of shell, 1 ft. 7½ ins.; depth of box at front inside, 7 ft. 4⅞ ins.; depth of box at back, inside, 6 ft. 4⅞ in.; heating surface in tubes, 2,160 sq. ft.; heating surface in firebox, 180 sq. ft.; total, 2,340 sq. ft.; area of fire grate, 27 sq. ft.

Weight of engine in working order—On bogie wheels, 18 tons 15 cwt.; on driving wheels, 19 tons 17 cwt.; on trailing coupled wheels, 19 tons 15 cwt.; on carrying wheels, 18 tons 7 cwt.; total, 76 tons 14 cwt.


ATLANTIC TYPE LOCOMOTIVE FOR THE NORTH-EASTERN RAILWAY OF ENGLAND.

The Natural Resources of the United States.

The United States Geological Survey has issued a coal chart which shows the amount of coal mined by States. The figures are very interesting. In the year 1814 only 22 tons of coal were mined, but by 1850 this had increased to over 7,000,000 tons yearly and in 1910 nearly 502,000,000 tons were taken from the ground. The total amount mined in the United States is 8,250,000,000 tons.

Besides this immense coal output the United States leads the world as an oil producing country, in fact it produces more than all the rest of the world together. In 1910 over 209,000,000 barrels of oil were yielded from over 148,000 wells, each of which produce on an average about four barrels a day.

Tractive Effort.

Among the general mass of correspondence that comes to us from all over the world, there is no question that appears so frequently as one involving the tractive power of locomotives. While the rules in regard to this question are simple enough and the tractive effort in pounds is easily determined, as shown in our answers to occasional correspondents the further problem of determining how many pounds of tractive effort are required to move a ton is a question that occasionally comes to us, and when it does come it is difficult to answer, as it depends altogether on conditions with which we may not be familiar. The practice of taking five or six pounds of tractive effort as sufficient to move a ton is very misleading. This figure may be assumed as a basis of tractive effort at the slowest degree of speed on a level track under the most favorable climatic conditions, but even with the increased force arising from momentum at high velocities, the tractive effort necessary to move a ton at a high speed is naturally much greater.

The best authorities agree that the element of axle friction only in train resistance is fairly determined at about four pounds per ton for passenger and loaded freight cars, and six pounds per ton for empty freight cars at a speed of ten to thirty miles per hour. The general law of friction is also well determined that at very high journal speeds the lubricants are so well carried around between the metallic surfaces that the friction is greatly reduced, and may almost became evanescent. At high speeds the journal friction proper may be less even than two pounds per ton.

At the instant of starting the axle friction is many times greater than after the vehicle is once under way, but the drop from this high resistance, while very rapid, is by no means instantaneous, but requires a speed of from five to ten miles per hour before the normal rate is attained. The starting resistance at times rises considerably

above twenty pounds per ton. This is readily demonstrated by a car on a 1 per cent. down grade, which gives an accelerating force of twenty pounds per ton, yet the car will not start of itself without aid. A force of sixteen pounds per ton will rarely start a car in motion. A fair average is about twenty pounds.

Perhaps the most exact data ever collected on this subject were the personal observations made by Angus Sinclair on the Empire State express locomotives nearly twenty years ago. With speed and pressure indicators of the most approved type and with a careful and repeated series of tests, the following facts were clearly demonstrated on a locomotive of the eight-wheel type, which, with tender, weighed about 100 tons. The load, consisting of four coaches, weighed 170 tons, making 270 tons in all. The cylinders were 19 x 24 ins., and the driving wheels 6½ ft. in diameter. At a speed of forty miles an hour with the valves cutting off the supply of steam at 8½ ins., the indicator showed an average pressure in the cylinder of 59 lbs. per sq. in., or a little over one-third of the boiler pressure, which was 170 lbs. The power exerted to move the train at this speed was 24 lbs. per ton. At sixty miles per hour the mean pressure in the cylinder, as shown by the indicator fell to a little over 40 lbs. per sq. in., showing that 15 lbs. per ton moved the train at this velocity. At a speed of nearly eighty miles per hour, the indicator diagrams showed an average pressure in the cylinders of a little over 47 lbs. per sq. in., which showed that 17½ lbs. per ton was exerted in keeping the train moving at this high velocity.

The conditions were particularly favorable for exact experiments, the run from New York to Albany being as nearly level and as nearly straight as any road anywhere, the curves, of course, being run at reduced speeds, the indicator being used on the long level stretches. It need hardly be added that the throttle valve and reverse lever were repeatedly experimented with, and while it may be imagined that a higher degree of mean pressure in the cylinder might be obtained by a longer travel of the valve, at a high velocity, however, this is not the case. The cylinders were allowed all the steam that they could use in the time that the rapidly moving piston could allow, so that the highest possible degree of force was exerted of which the locomotive was capable.

It will thus be seen that in calculating the tractive force of a locomotive, the common rule of taking 85 per cent. of the boiler pressure as the force exerted upon the piston is very misleading. No moving piston is capable of receiving such force, even at the slowest degree of speed. Eighty-five per cent. may properly be called the very highest degree of starting power, and when a speed of forty miles per hour is reached, as we have already stated, the cylinder pressure is only about one-third of the boiler pressure. It will be readily understood that at the beginning of the stroke of the piston the full boiler pressure may be for a moment exerted, but this can only be maintained during a short part of the stroke, both for practical as well as economical reasons, after the engine has obtained some momentum.

In regard to resistance due to grades, the exact figures are more easily reached. If the steepness of the grade in feet is multiplied by 0.38, the quotient will be the resistance in pounds per ton. Suppose the grade is one-half of 1 per cent., or 26.4 ft. per mile, we have the problem, $26.4 \times 0.38 = 10.032$, or a fraction over 10 lbs. per ton to be added to the resistance that would occur on a level track.

The resistance due to curves depend much on physical conditions and upon the length of train that is on the curve. The common rule is to add 1½ lbs. per ton for each degree of curvature.

New Type of Locomotive for the Pennsylvania.

One of the largest locomotives in the world has just been built for the Pennsylvania Railroad. It will be tried in freight service on steep grades of the mountains in western Pennsylvania, and if it proves satisfactory this type, known as the H-H-1, may be adopted.

The new engine is longer than the Pennsylvania's new all-steel coaches. From the point of pilot to the pulling face of the coupler on the rear of the tender the distance is 98 ft. 3¾ ins. The weight of the engine in working order and the tender loaded is 668,900 lbs. This is 238,900 lbs. heavier than the class K-2, the heaviest passenger engine, and 272,600 lbs. heavier than the class H-8-b, the heaviest freight engine which the Pennsylvania is now using. It is 644,275 lbs. heavier than the John Bull, the Pennsylvania's oldest locomotive.

There are four cylinders, each having a diameter of 27 ins. and a stroke of 28 ins. Each of the 16 driving wheels is 56 ins. in diameter. The steam pressure is 160 lbs. and the total heating surface 7,723.6 sq. ft.—3,103.7 more than on the K-2. On the John Bull the heating surface was only 213 sq. ft. The inside dimensions of the fire box are 12 ft. and ⅛ in. by 8 ft. and ¼ in. The tender will hold 9,000 gals. of water, and 30,000 lbs. of coal. The performances of this locomotive will be watched with much interest.

Runaway Tricycle.

The tricycles which telegraph linemen, roadmasters and others use as vehicles of transportation over railway tracks, provide the means of manual locomotion for a small amount of power. For the speed that these tricycles can be worked up to by the lever provided, the vehicles are fairly safe, but they are not calculated for express speed, and they are daring men who ride these three-wheeled jumpers at a speed above twenty miles an hour. Jim Cary, a lineman on a Northwestern railroad, made a flying trip on one of these machines that was very exciting. Jim was in a hurry to get to St. Paul and finding one express train ready to start from a junction he coupled to the hind end by means of a wire intending to let go when the train got over a steep hill that was in front. But when the train got to the top of the grade, Jim found that the plyers for cutting the wire had been jerked out of the tool box. The speed kept increasing rapidly and the lineman found it impossible to undo the connection, for the tricycle jumped and plunged in a fearful fashion. When a speed of about fifty miles an hour was reached the train struck a sharp curve. Curves are not adapted to three-wheeled vehicles running at high velocity, so this tricycle, following true mechanical laws, attempted to keep going in a straight line. The effort was resisted by the coupling wire. The composition of forces inclined towards the clouds and consequently tricycle and rider went upwards in a big flight. They were like the pig in the song—badly adapted to flying—and they came down to mother earth with terrific contortion.

Singularly enough Jim escaped with a few bruises—but the tricycle. A farmer came along the next day and swore that some miscreant had put his old harrow upon the track. He would sue the com pany.

The Air Brake Association.

At a meeting of the executive committee of the Air Brake Association, held in New York City recently, it was decided to hold the nineteenth annual convention of the Air Brake Association at Richmond, Va., May 5-10, 1912. The headquarters of the convention will be located at the Hotel Jefferson. The selection seems to meet with universal approval among the air brake men and the attendance will, in all probability, be unsually large.

New Branch of Baldwin's.

The Baldwin Locomotive Works have decided on the Calumet region as the location for its proposed Western plant. A site has been selected near Hammond, Ind. Work on the new plant will probably be begun before spring.

General Correspondence

Improved Lock Nut.

Editor:

Enclosed is a sketch of a new form of lock nut for rail connecting. As you know, at present the constant and heavy concussion of passing trains tend to loosen the lock nuts now in use. In the drawing that I am sending, the device will almost explain itself. The idea is original with me, and I think that it would make it impossible for the nut to become loose. To begin, it would require no change in the fastening plate. You will note there is a recess or indentation in the plate to al-

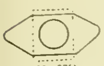


FIG. 1.

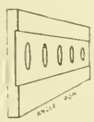


FIG. 2.

FIG. 3.

low a thin plate of mild, open-hearth steel to fit in the recess, and when the bolt is inserted the extended ends of the thin piece of steel can be readily turned up, as shown in the drawing, and so secures the nut from the possibility of turning. The details may readily be followed in the drawing. Fig. 1, showing the perforated piece of steel. Fig. 2, the plate with recess adapted to receive the thin plate or washer. Fig. 3 shows sectional view of rail with plates and bolt and nut and locking washer in finished position.

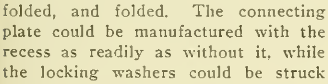


FIG. 4.

Fig. 4 shows side view of rails connected with bolts and nuts holding plate and washers unfolded, partially folded, and folded. The connecting plate could be manufactured with the recess as readily as without it, while the locking washers could be struck off with a degree of rapidity that would leave nothing to be desired.

THOS. J. PRATT.

Paterson, N. J.

Superheated Steam.

Editor:

Referring to the letter of Mr. W. L. Blennerhasset, which appears on page 503, of your issue for December, 1911, relative to the increase of power in locomotives using superheated steam.

The opinion that this is due to an increase in the terminal pressure of expansion, will not hold, as various investigators have determined that the behavior of superheated steam is very similar to that of the perfect gases, hence its terminal pressure is invariably lower than that of saturated steam. If the superheat is sufficiently high, the exponent of its equation becomes unity, whereas without any superheat there is alternate condensation and re-evaporation, and the exponent varies with the condition of the steam, the value 1.0646 assigned by Zeuner, being the one most usually employed in engineering calculations. With the exponents of the equation P. V. equals constant, in a ration of 1 : 1.0646, the pressures after expansion will vary in a like ratio.

The reasons for the increase of power are probably as follows: 1. The largely increased volume of superheated steam as compared to that of an equal weight of saturated steam, which means that for a given volume to be admitted to a cylinder, there will be less weight involved, which would entail less friction and wire-drawing through valve and port; also with the larger volume, we may use longer cut-offs. 2. The lessening or even the complete elimination of condensation losses. 3. Investigations of the action of steam jets, as a means of producing draught in the furnaces of steam boilers, have proven conclusively, that dry steam is more efficient than that which carries a percentage of moisture, hence with steam sufficiently superheated to keep it dry to the point of release, the blast action will be better and the smoke-box vacuum improved, although with some superheater designs, the obstruction of draught, due to its construction, may entirely wipe out this gain.

As an example, let us consider the original superheater engine of the Canadian Pacific Railway and the ordinary one against which it was tested, dimensions of which follow:

A "Schmidt" smokebox superheater, a type which does not impair the effectiveness of the evaporative heating surface, was employed.

The ratio of water heating surfaces, in the two boilers, is as 865 to 1,000, hence 86.5 per cent. of the heat generated on the grate of the superheater engine would be sufficient to make the evaporative ratios equal per unit of area, in the two boilers; this leaves 13.5 per cent. available for use in superheating.

An examination of the steam tables of "Marks and Davis," given in "Kent," eighth edition, shows that it requires 11.7 per cent. additional heat to superheat steam of 180 lbs. absolute pressure, to a temperature 300 degs. above its temperature of saturation, so it is probable that the available heat will be sufficient.

Assuming that 8 lbs. of water are evaporated per square foot of heating surface per hour, the saturated evaporation, total per hour, of the boilers would be 8,928 and 10,328 lbs, for equal weights of fuel consumed. The volume of 1 lb. of steam at 180 lbs. absolute pressure, and with 300 degs. superheat, is 3.72 cu. ft. and that of a pound of saturated steam at the same pressure is 2.533 cu. ft. From these figures we see that we will have 33,212.16 cu. ft. of superheated non-condensible steam and only 26,160.82 cu. ft. of saturated steam available for use in the engine. The ratio of the volume is as 1.26 to 1, or, more exactly, 1.2695 to 1, and if both fluids expanded alike without any losses, we could expect nearly 27 per cent. more work from the superheat engine than from its competitor, but as before noted, the equation P. V. equals constant, is not alike in the two cases, and therefore we must vary the ratio of work by the ratio of the exponents of the equation, 1 to 1.646. Dividing 1.2695 by 1.0646, we get 1.249 as the exact ratio of work in the two engines, which would be absolutely correct, were there no losses in either engine from condensation or leakage.

	Superheat.	Saturated.
Type	4-6-0	4-6-0
Kind	Simple	Simple
Cylinders	18 ins. by 24 ins	18 ins. by 24 ins.
Driving wheels	62 ins.	62 ins.
Total heating surface (water)	1,116 sq. ft.	1,291 sq. ft.
Grate surface	23.44 sq. ft.	23.44 sq. ft.
Superheating surface	307 sq. ft.	....

It is a well-known fact to engineers that leakage in an engine using superheated steam, is far greater than with saturated steam, where every joint is water packed, if the holes are not too large, and the writer has known of cases where the leakage with superheat was greater than the condensation loss with saturated steam, but it is never sufficiently large to overcome the increased volume due to the superheat, and it is probable that the application of properly proportioned superheaters will always result in gain, either of power or efficiency.

From the above it is evident that to get the full benefit of superheat, the cylinders should always be larger than those of like engines for saturated steam, and had the cylinders of the engine on the C. P. R. been 19.75 ins. in diameter instead of 18 ins., it is probable that a better showing would have been made. In this connection, it is well to note that the prominent builders are now equipping superheater engines with cylinders larger than were formerly applied.

C. F. PRESCOTT.

Philadelphia, Pa.

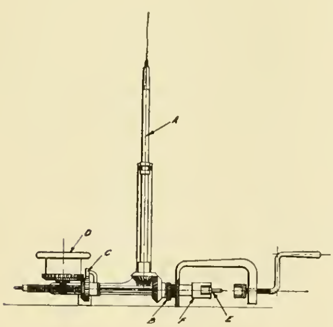


FIG. 1.

Flue Sheet Drill.

Editor:

The drilling and countersinking of flange holes in flue-sheets has always been a rather difficult and tedious operation, especially in shops that are not equipped with a flange punch. To overcome this difficulty we are using a rail-drill modified as shown in the accompanying photograph and sketches.

Figure 1 gives an idea of the machine we are using. The driving spindle "A" is provided with a standard Morse taper. "B" is the eccentric which operates the feed pawl "C", while the hand-wheel "D" is used for returning the drill. "E" and "F" are the drill and countersink and depth-gauge respectively and are shown on an enlarged scale in Figure 2. The depth-guage is provided with slots to prevent chips from packing around countersink.

The driving spindle, being provided with a standard drill-taper, can therefore be used in connection with a radial drill-press with the flue-sheet in a horizontal position. With this machine we are enabled to drill and countersink about 25 holes per hour without moving the flue-sheet during the operation. This advantage is obvious. In addition we are getting better results than when the holes were flange-punched.

BERT SMITH,
General Foreman.
K. C. M. & O. Ry., Wichita, Kansas.

Problem of a Revolving Disk.

Editor:

In your "Questions Answered" column, No. 119 is a request for an explanation of the behavior of an unbalanced disk when rotated. Of course it is understood that the axis of the shaft is not rigidly held in place. It is itself more or less flexible, there is some play between it and its bearings, in which the only agent tending to hold it central is the film of oil, and the bearings themselves will yield in a greater or less degree according to their construction. Now an unbalanced disk will have its center of gravity at a little distance from the center of rotation; and, consequently, when the shaft begins to turn it will exert an outward force, drawing the shaft toward it, just as the centrifugal force of the boy's "sling shot" produces a pull on the string. The radius of the circle in which the center of gravity of the disk moves is increased by the amount that the shaft yields. Let "d" represent the distance the shaft and its bearings yield, "a," the distance between the center of the shaft and the center of gravity of the disk, "r," the radius of the circle in which the center of gavity moves, "p," the velocity of turning, and "C," some quantity depending upon the weights and flexibility of the apparatus, which, in a given case, does not change, and so does not interest us particularly. Then the following relation is very nearly obtained: $d = r\,p^2\,C$. This is very natural, for the yielding of the shaft would be practically proportional to the centrifugal force, and the centrifugal force would be proportional to the product of the radius, and the square of the velocity of revolution. Another form of expressing the foregoing relation is as follows: $\frac{d}{r} = p^2\,C$. From this it is evident that when the speed is comparatively slow, and "p" is therefore small, "d" must be small in proportion to "r." That is the condition at starting; the heavy side draws the shaft outward, adding the "d" to the "a" for the radius "r," and the heavy side will be marked by the chalk. On the other hand, when the speed is high, "p" is large, and "r" is small in proportion to "d." Now the only way in which the radius can be small in proportion to the deflection of the shaft is by the shaft deflecting in the opposite direction; that is, away from the center of gravity of the disk. The center of gravity then tends to coincide more and more closely with the center of rotation, as the speed increases, and the light side protrudes and receives the chalk mark. The speed at which the shaft changes its direction of yielding from that toward the heavy side to that toward the light side, is called the "critical speed," and this change is accompanied by the violent vibrations mentioned. This subject has been given a very thorough study by the technical staff of the General Electric Company, which has brought out an immense quantity of information of great practical value to the designer of such apparatus as steam turbines, generators, and frequency changes. The importance of the subject lies in this fact: Perfect balance being impossible, the apparatus must be so designed that the critical speed shall be far from the running speed, and the shaft shall be strong enough to carry it safely past the critical speed, yet flexible enough to allow the center of gravity to come as close to the center of rotation as possible at the running speed.

G. E.

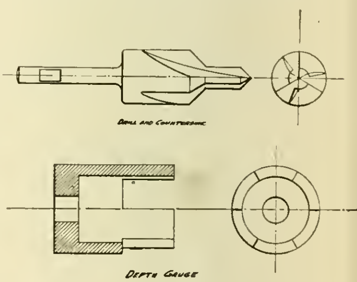


FIG. 2.

Securing Eccentrics and Working on Cabs.

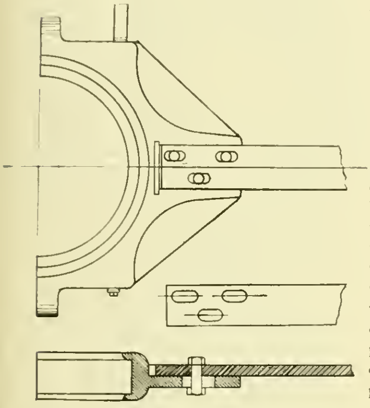
Editor:

Attached prints show two of our latest "shop kinks" here. The first illustrates a method of preventing eccentric blades from shifting from their proper positions, after they are once exactly set, by applying cast pieces of babbitt metal in the slotted blade holes on each side of bolts holding the eccentric and blade together. This method has prevented many engine failures where blade nuts have become loose, and the

babbitt blocks held the blade in its original position. Further descriptive details need not be given, as the print shows the method of procedure with a sufficient degree of clearness.

The other print shows details of a very handy painter's scaffold that may be readily attached to the side of a cab and running board, and thereby avoid the usual cumbrous scaffolding rising from the flooring. It was designed by our foreman painter, Mr. A. Rosenberg, and has been found very useful for all classes of work on the cab, not speaking of other kinds of work that may be proceeded with uninterruptedly underneath.

CHAS. MARKEL,
Shop Foreman.
C. & N. W. Ry., Clinton, Iowa.



ECCENTRIC STRAP AND ROD SHOWING BABBITT METAL FILLING SLOTS.

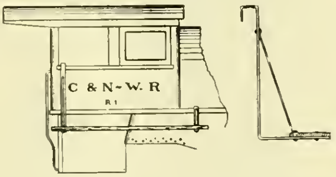
Business Outlook.

BY J. HAMPTON BAUMGARTNER.

An important factor in the restoration of confidence in business has been the change of attitude of legislative bodies toward the railroads and other large business interests of the country, through a subsidence of the wave of antagonism so prevalent a few years ago. While yet too early to see the full measure of this change, it is clear that the people at large are commencing to realize the impossibility of legislative enactment to constantly increase the expenses of the roads and the commission refuse the increasing of rates, and at the same time attract larger investments of money in sections of the country greatly in need of development.

The present condition of business and the outlook for 1912 are such that there is no real cause for unrest nor indications pointing towards failures of any moment. Manufacturers are not overstocked with raw materials, which, of course, means that little, if any, depression would be felt through fluctuation of prices. Within the past few months a material improvement has been noted in the steel and iron trade, with prices gradually rising to such a plane as to bolster up trade.

A reliable barometer of the country's trade relations is to be found in the railroad situation, which at this time is quite encouraging. The railways, while feeling keenly the failure to secure approval by the Interstate Commerce Commission of their proposal for increased rates, following the granting of large increases in rates of pay which were not only concurred in but, in fact, made by Government direction through the mediation law, have accomplished their excellent showing of the past year through careful management and such curtailing as could be effected with a proper maintenance of operating efficiency. The railways during the year purchased unusually large quantities of new equipment, many of them having placed the largest orders in their history. The purchase of equipment by the railroads is looked upon with special significance as indicating increased traffic demands during the coming year. The construction of new equipment will provide additional work for thousands of skilled mechanics and other laboring classes. Baltimore shops were fortunate in receiving a 2,000-car lot of the Baltimore & Ohio order recently placed. Improvements were also carried on by the railroads on a large scale during the year, entailing enormous expenditures of money.



PAINTER'S SCAFFOLD FOR CAB.

The Baltimore & Ohio being one of the leading coal-carrying roads, as well as one of the important arteries of trade in point of volume of tonnage, the statistics of the business handled on the lines of the system during the year are pertinent to general conditions.

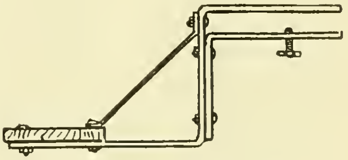
Allen Paper Wheel and its Inventor.

We recently received a letter from a foreign railway official asking by what process paper could be hardened so that it stood the shocks due to impact with steel rails. That represents a misunderstanding concerning paper car wheels by no means uncommon. For the benefit of those who are ignorant of the construction of paper car wheels we wish to explain that paper forms the wheel center. A special kind of paper composed of numerous sheets is squeezed in a hydraulic press into the shape required for a wheel center and bolted securely to a flanged tire and to the center which holds the axle. There is some resilience to the paper center which is supposed to modify the shocks of car service.

The inventor of that kind of wheel was R. N. Allen, who died at Cleveland in 1890, aged 65 years. Mr. Allen was a New England man and in early life entered railroad life as a fireman on the Connecticut River Railroad, where he advanced to be an engineer. Afterwards he ran an engine on the Cleveland & Toledo Railroad, where he rose to be master mechanic. When the Civil War began he accepted a position as railway master mechanic under the Government, and went through very trying experiences in the South during the war time.

When peace was proclaimed, Mr. Allen returned to New England. Feeling that he had gone through all the railroad experience that he wanted he entered the business of making paper strawboard, which eventually suggested the idea of making car wheel centers from strawboard. The invention was developed very slowly, but the inventor was one of the persistent men whom difficulties rouse to greater effort.

Railroad men nearly all ridiculed the idea that paper car wheels were practicable, but Allen had a persuasive manner, and thoroughly believed that paper centers would make a smooth riding and a durable car wheel. Finally the management of the Rutland & Burlington Railroad consented to try a set of paper wheels under a passenger car, and the performance gave something to talk about. To tell that a passenger car was carried on paper wheels was something startling, most people, like our correspondent, believing that tires and axle portions were of paper. Popular belief in the paper wheel developed slowly, but apathy could not intervene between the public and anything advocated by Richard N.



SCAFFOLD ATTACHMENT FOR RUNNING BOARD.

Allen, for by some means all the railroad men in the country were discussing the novelty of paper wheels.

George W. Pullman was one of the most conservative men in the world, but somehow he became interested in the Allen paper wheel and helped the inventor to organize a company for the manufacture of the wheel, which proved a financial success. In addition to inventing the wheel, Mr. Allen invented a suitable tire and cast steel center for the wheel. He spent several months at the Krupp Steel Works in Germany, perfecting the model.

Richard N. Allen has the right to be classed as one of America's great inventors, yet his name has not yet appeared in any of our biographical directories that are crowded with the doings of politicians, lawyers and preachers.

Prevention of Smoke.

By T. A. Lawes.

The prevention of smoke is being required by a number of large cities, enforced by ordinances and penalized by fines. The prevention of smoke from locomotives has engaged the attention of thoughtful men commencing almost with the advent of the locomotive. It is important that proper equipment be used and properly located if the best results are desired. I was led to write this article by observing locomotives completely equipped with the most approved smoke preventing devices, the successful operation of which was defeated by a wrong location of the equipment.

A locomotive properly equipped for prevention of smoke should have, in my opinion, three devices installed: (1) a brick arch, (2) steam inducted air jets, and (3) a powerful blower.

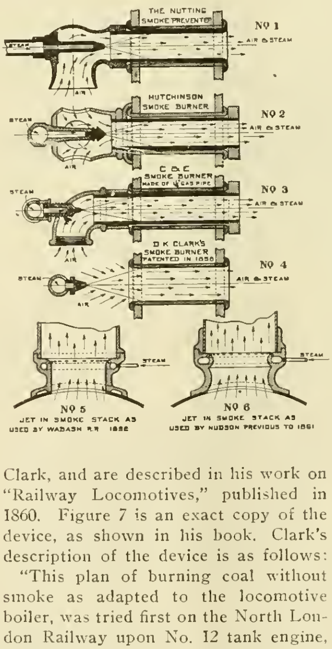
BRICK ARCH.

A brick arch is a source of economy in the burning of coal and is also a good smoke consumer. In the past, while its merits as a coal economizer and smoke preventer has not been questioned, yet in bad water districts, the cost of replacing the arch when it had to be torn out for repairs to firebox and flues, made it a costly proposition, and outweighed its obvious advantages of fuel economy and prevention of smoke. For this reason a large number of railroads using the arch, gave it up. Its disadvantages outweighed its advantages.

There has been put in the market lately a new design for an arch called the "Security," which overcomes the foregoing objections regarding fire brick arches in general. The Security arch is made in sections and is so light it can readily be removed and replaced. It is thin and cools down so it can be handled in twenty minutes from the time the fire is withdrawn. If work is to be done, one section can be taken out without disturbing other sections. I consider that the Security arch overcomes all the objections which were found to exist with the ordinary arch heretofore used. The brick arch is a first rate smoke preventer when the engine is running.

STEAM INDUCTED AIR JETS.

While a brick arch will lessen the amount of smoke while the locomotive is running, yet when stopped with a green fire, smoke will appear; so we will need an apparatus that will control the smoke when the locomotive is not moving. In steam inducted air jets we have a powerful ally to prevent smoke. Steam inducted air jets were patented in 1857, by the eminent engineer, D. K.



Clark, and are described in his work on "Railway Locomotives," published in 1860. Figure 7 is an exact copy of the device, as shown in his book. Clark's description of the device is as follows:

"This plan of burning coal without smoke as adapted to the locomotive boiler, was tried first on the North London Railway upon No. 12 tank engine, in January, 1858. The firebox was 3 ft. 6 ins. wide and 3 ft. long, four tubular openings, in a row, 1½-in. diameter, were made through one side of the firebox only, the other side being blocked by a coke box. Air was admitted through these openings, and delivered over fuel and forcibly inducted when necessary by means of four jets of steam from the boiler, 1/16 in. in diameter, pointed into the openings. . . . This is the first instance on record, in which coal smoke could be effectually prevented in a locomotive without the assistance of the blowpipes."

Clark shows six air tubes in the small firebox of that period. I have seen locomotives equipped with only two tubes to the firebox, which arrangement is wholly inadequate. In Holley's "American and European Railway Practice," published in 1861, the author hits off the practice of not equipping a locomotive with sufficient air tubes in the following words: "Several locomotive superintendents have tried Clark's jets, which is a forcible induction and mixture of air with the gases at the surface of the fire by jets of steam, and they have abandoned it as inefficient. Instead of approximating the capacity and position of the apparatus used by Clark, which is at least six 2-in. hollow staybolts, at the surface of the fire for admitting air, one of these experimenters had put in three ½-in. staybolts under the door with steam jets blowing air through them straight into the flues." In my own practice one 2½-in. tube to each four feet of grate surface is found to be satisfactory.

In regard to the proper location of air tubes, I prefer them placed on the sides of firebox and then placed in alternate position, so steam cannot blow from the tubes across the fire and out the opposite tube. In locating them from the grate surface, we find, in existing locomotives, these tubes are located all the way from 18 to 36 ins. above the grate surface. I have conferred with chemists about the proper location for these tubes, and they tell me that the air should go into the hottest part of the flame before the smoke is made. The tubes should be located about 3 ins. above the thickness of the fire necessary to be carried. A definite distance from the grate cannot be given for the reason that the thickness of fire for best results varies with the quality of the coal, and must be determined by experience.

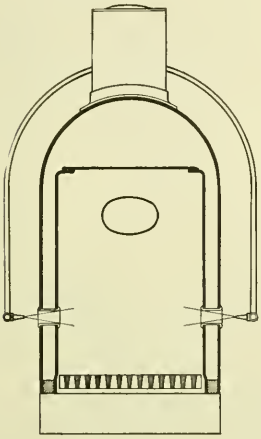
I noticed on one of the truck lines a locomotive equipped with air jets, with steam nozzle located as shown in Fig. 9.

The steam jet has no inducing action on the air. The air tube would be just as efficient without the steam jet located as it is.

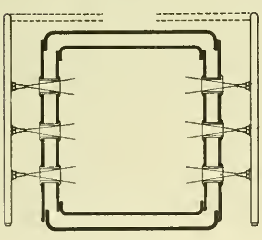
Some years ago I made a series of tests in regard to the proper relation of the steam nozzle to the air tube in order to get a position that would furnish the largest amount of air. The tests occupied about one week, and during that period forty changes of position of nozzle were measured, two designs of nozzle were also tested, a nozzle of greatest discharge and a nozzle of greatest velocity. Briefly, the result, checked by a sensitive manometer, was found to be that nozzle should be placed 4 ins. from the end of a 2½-in. air tube. Fig. 8 shows the best

position for the nozzle. The one shown here is a nozzle of greatest velocity, which gave the best results. A powerful blower is a useful auxiliary in the prevention of smoke. When an engine is shut off and before the air jets get to work, the firebox flues and front end are full of smoke that cannot be, for the instant, controlled by the air jets. In such cases the blower makes up the deficiency.

The blower pipe should not be less than 1¼ ins. in diameter, with a quick-opening, independent valve, so arranged that it can be used by either engineer or fireman, and an automatic valve which turns steam into the blower



NO 7



COAL BURNING BOILER BY D.K.CLARK — LONDON 1858
APPLICATION OF STEAM INDUCTED AIR JETS

pipe and air jet pipes when the throttle is shut off. The independent valve is for use in case the automatic valve gets out of order. Nos. 5 and 6 show blowers located in the smokestack base. No. 6 was designed in 1861 by Mr. Hudson, superintendent of the Rogers Locomotive Works. No. 5, a copy of No. 6, was in use for years on the Wabash R. R. Blowers have also been made by using a circular pipe pierced with small holes located just below the smokestack base. This arrangement can be applied without making a new stack base. A very good method, if not the best, is to arrange the blower openings on an annular ring surrounding the exhaust nozzle.

While engine is running, the firebrick arch takes care of the smoke. When a stop is made an automatic valve operated by the throttle lever is opened and steam is turned in blower pipe and air jet pipes. Smoke is thus controlled under all conditions. About fifty-three years ago, D. K. Clark stated that the desirable apparatus for smoke prevention was the firebrick arch, steam inducted air jets and the blower. With all the progress we have made since his day, we have not been able to improve on his suggestion.

Inventors have taken as a basis for starting work on a new smoke burner, the steam inducted air jets of D. K. Clark. Then they get a patent on some construction feature. Nos. 1 to 3 show the different styles of air jets patented since Clark's day. The patents have long since run out and may be used without paying royalty. These designs have some merit. Nozzles arranged as in No. 4 are prone to get out of the exact center of air tube due to the expansion of the pipe that carries them. In Nos. 1, 2 and 3 the nozzles are well supported and alignment is always secured. It appears to me that the following equipment is necessary to prevent the emission of dense smoke.

(1) A fire brick arch in sections, so one section can be removed without disturbing the balance of the installation.

(2) Steam inducted air jets, nozzle 4 ins. from tube end, located 3 ins. above the fire carried and one 2½-in. tube to each 4 sq. ft. of grate surface.

(3) An annular blower either around the stack base or just below the stack base, or surrounding the nozzle. To be supplied with steam by a 1¼-in, pipe.

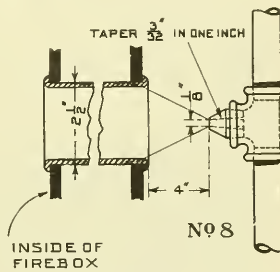
(4) An automatic valve connected to the throttle lever and so arranged that when throttle lever is shut off the automatic valve opens and steam is supplied to the blower and air jets.

(5) An independent blower valve that can be used if the automatic valve gets out of order. The independent valve should be a quick opening one. Screw valves are too slow.

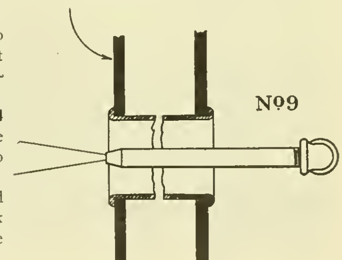
Resources for Peat Industry.

On the assumption that there are in the United States, exclusive of Alaska, 139,855 square miles of swamp lands, it is estimated that 8 per cent. of this area, or 11,188 square miles, will have peat deposits of good quality. Assuming further that the average depth of the peat in this area is at least 9 ft., and that the average yield will be 200 tons of salable fuel per acre for each foot of depth, the total available fuel in these deposits will reach 12,888,500,000 tons; this quantity, if converted into machine-peat bricks and sold at $3 per ton, would have a value of $38,665,700,000—no mean resource, but one that would furnish heat and power for the entire country for many years.

Comparing the cost of peat with that of coal, the former could be produced with less danger, and with much less expensive equipment if it needed only to be dug, because it lies at or just below the surface of the ground. A readily marketable type of peat fuel, in the form of air-dried, slightly compressed blocks, can probably be produced at an expense of from 75 cents to $1.25 or $1.50 per ton, and with properly devised and properly arranged machinery production on a large scale would considerably lower the higher price for peat of well-decomposed types.



NO 8



NO 9

New Process for Steel Castings.

A new process for manufacturing steel castings for commercial purposes has been introduced at a foundry at Christchurch, New Zealand, and will soon be in operation. In the new method the crucible process is discarded; special pig iron is used and is dealt with in a cupola. From the cupola it is transferred in a molten condition into a huge iron converter. There it is brought into contact with cold air, supplied through a pipe, at a pressure of 7 lbs. to the square inch. The metal is at a very high temperature, and the conversion takes place very rapidly. It is stated that the metal itself is converted from pig iron into steel in 14 minutes. Besides the great saving in time, the appliances the firm is installing will enable it to deal with any quantity at a day's working from 1,000 lbs. up to 6 tons.

American Locomotive Company's New Pacific Type Locomotive

It is interesting to note that in celebration of the 50,000th locomotive built by the American Locomotive Company, designed and constructed at their own expense as an experiment, it has already developed 2,216 horse power, being 121.4 pounds of weight for each horse power.

This locomotive, a Pacific type, illustrated herewith, was developed in consequence of the thoroughly appreciated need of greater sustained capacity to meet the maximum requirements of modern passenger service. It represents an effort to determine the limits to which the efficiency and capacity of a passenger locomotive of a standard wheel arrangement could be developed without exceeding conservative weight limitations through the fullest application of the latest approved developments in locomotive design and materials.

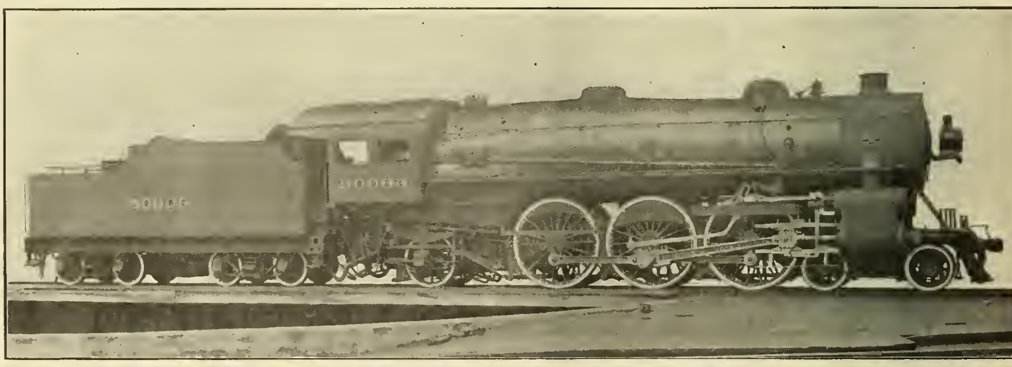
Untrammelled by any outside specifications or the necessity of conforming to any railroad's existing standards, the builders had free hand to embody, in this design, their ideas of the best practicable locomotive engineering practice.

To accomplish the purpose of the design—the maximum capacity per pound of weight—the largest boiler capacity within the predetermined wheel loads was the essential feature.

This end was obtained by eliminating every pound of weight in all the parts that was not necessary to strength or durability and by utilizing the weight thus saved to provide a larger boiler and by increasing the capacity of the boiler thus secured by combining in one design the most approved fuel saving devices to obtain the utmost economy in boiler and cylinder performance.

The superheater is of the type "A" with top header and double looped superheater tubes. It consists of 36 four tube superheater units. A damper of the usual design is provided which automatically regulates the flow of gases through the superheater flues when the throttle is shut off. To further increase the boiler capacity through improved boiler economy, the firebox is equipped with a "Security" sectional brick arch. Aside from this large boiler capacity, the number of new features introduced in this design with a view both of saving weight and securing improved economy in operation make this locomotive one of the most interesting of recent construction.

Among these new features, the following are worthy of particular notice, cast steel cylinders with cast iron bushings. steam pipes arranged to connect with the cylinders outside of the smoke box, screw reverse gear, a self-centering guide for the valve stem, a new arrangement of guide for the extended piston rod end, and an improved outside radial trailing truck.



FIFTIETH THOUSAND LOCOMOTIVE BUILT BY THE AMERICAN LOCOMOTIVE COMPANY.

By the use of the screw reverse gear instead of the ordinary lever, locomotive No. 50000 introduced what promises to be a most important and beneficial change in American locomotive practice, both from the standpoint of economy and ease of operation.

The screw reverse gear can be easily arranged to give about eleven times the leverage obtained with the reverse lever as usually proportioned. The wheel can be spun around very rapidly so that only from four to six seconds is required to completely reverse the gear, which is probably faster than can be done with the ordinary reverse lever because of the time consumed by the engineer in getting into position and well braced before he can exert sufficient muscular force to throw the reverse lever.

Another important improvement in detail design is the self-centering guide for valve stem. The chief advantages of this arrangement is that it can be erected, taken down and replaced without any lining up, at the same time insuring that the valve stem guide is absolutely in line with the piston valve chamber. This saves all the time that is spent in lining up the valve stem guide of the ordinary construction employed with the Walschaerts Valve Gear when it is necessary to take down the valve motion.

For these and other reasons, this locomotive merits investigation and the most careful study of all the details of its design on the part of all railroad officials interested in locomotive operation and its performance on the Erie Railroad on which it is running and of which a full account will be given in a later issue.

The following are some of the principal dimensions of this locomotive:

Cylinder—Type, simple piston valve; diameter, 27 lbs.; stroke, 28 ins.; track gauge, 4 ft. 8½ ins.; tractive power, 40,800 lbs.

Wheel base—Driving 14 ft.; rigid, 14 ft.; total, 35 ft. 7 ins.; total, engine and tender, 68 ft. 2½ ins.

Weight—In working order, 269,000 lbs.; on drivers, 172,500 lbs.; total, engine and tender, 430,500 lbs.

Heating surface—Tubes, 3,800 sq. ft.; firebox, 220 sq. ft.; arch tubes, 28 sq. ft.; total, 4,048 sq. ft.; superheater, 897 sq. ft.

Grate area, 59.75 sq. ft.

Axles—Driving journals, main, 11 ins. x 12 ins.; others, 10½ ins. x 12 ins.; engine truck, journals, diameter, 6½ ins.; length, 12 ins.; trailing truck journals, diameter, 8 ins.; length, 14 ins.; tender truck journals, diameter, 5½ ins.; length, 10 ins.

Boiler—Type, conical conn.; O. D. first ring, 76⅜ ins.; working pressure, 185 ins.; fuel, bitum. coal.

Firebox—Type, wide; length, 114⅛ ins.; width, 75¼ ins.; thickness of crown, ⅜ in.; tube, ½ in.; sides ⅜ in.; back, ⅜ in.; water space, front, 4½ ins.; sides, 4½ ins.; back, 4½ ins.

Crown staying, radial.

Tubes—Material, lap welded char. iron; number, 207; diameter, 2¼ ins.; length, 22 ft,; gauge, 11 B. W. G.

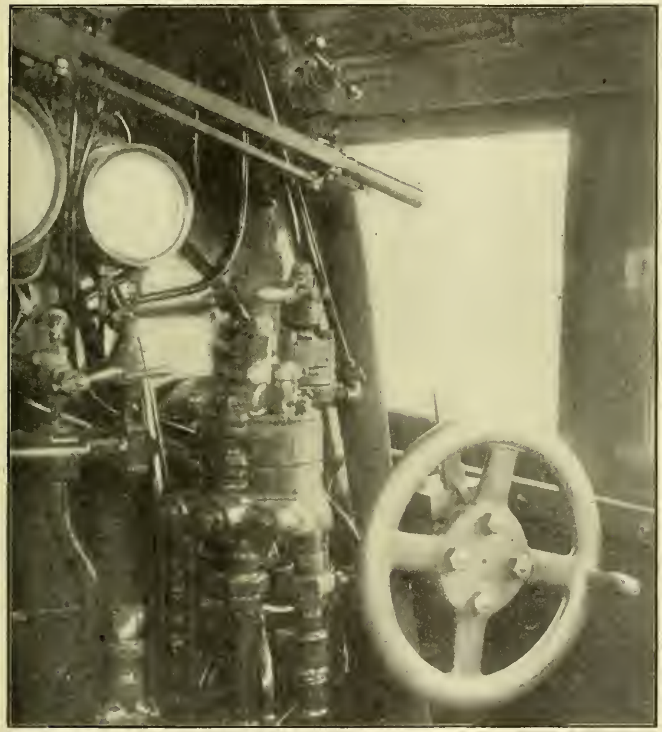
Boxes—Driving, main and others, cast steel.

Brake—Driver, truck, trails, tender, air signal, West. Amer. combined; pump, 8½ ins. C. C.; reservoir, 2-28½ x 53½ ins.

forward, ½ in, in full gear backward.

Wheels—Driving, diameter, outside tire, 79 ins.; centers, diameter, 72 ins.; driving material main and others, vanadium, cast steel; engine truck, diameter, 36 ins.; kind, spoke center; trailing truck, diameter, 50¼ ins.; kind, spoke center; tender truck, diameter, 36 ins. Flues—36-5½ ins. diameter; 22 ft. long; 3/16 in. thick, lap welded char. iron.

The reports in regard to the performance of this locomotive are being carefully tabulated and will be published at an early date.



SCREW REVERSE GEAR.

Engine—Truck, 4-wheel swing cen. bearing; trailing, A. L. Co.'s latest with outside journal; exhaust pipe, single; nozzle, 6⅜ ins., 6⅝ ins. and 6⅞ ins.; grate, style, rocking; piston rod, diameter, 4¼ ins.; piston packing, cast iron rings; smokestack, diameter, 18 ins.; top, above rail, 14 ft, 7⅞ ins.

Tender—Frame, type A. L. Co.'s 13-in. steel channels.

Tank—Style, water bottom, capacity, 8,000 gals.; fuel capacity, 14 tons.

Valves—Type, piston; travel, 6½ ins.; steam lap, 1¼ ins.; exhaust lap, C. L. ¼ in.

Setting—Lead, ⅛ in. in full gear

The Locomotive Cab.

The question, who first applied a cab to a locomotive for the protection of the enginemen will never be settled. There are several people credited with being the first to introduce a cab to cover the foot-plate of a locomotive, but there is no certainty about any of the claims until we come to the "Samuel D. Ingham," built at Philadelphia in 1835.

The necessity for having a cab to shelter the men operating a locomotive was not recognized for years after railroads were put in operation. The need for protecting enginemen from the weather was not regarded as being more urgent than that of sheltering stage coach drivers and marine pilots whose occupation exposed them at all times to the weather. When the proposal was first made in Britain to protect enginemen from the weather, it met with noisy opposition, as being calculated to enervate a highly worthy class of men, and the argument was considered so forcible that little attention has yet been bestowed in Europe to protect enginemen from the heat of summer and the rigors of winter weather. Probably the same kind of arguments were used on this side of the Atlantic in early railway days, for the application of inventions designed to shelter the enginemen made little progress till about ten years after the first American railroad started running trains.

Crude appliances were introduced on different railroads, especially in the North, to shelter enginemen, and old men used to be met with from all parts of the country who claimed that the road they worked on was the first to introduce a locomotive cab; but the idea progressed so slowly that as late as 1847 Sellers steep grade locomotive was illustrated with nothing more than the boiler head to shelter the enginemen.

David Matthew, one of the first master mechanics of the Mohawk & Hudson Railroad, claimed to have applied a cab to a locomotive in the early 30's, but no particulars were ever given and David had a weakness for claiming to be the originator of nearly all locomotive improvements. The first exact record of a cab being applied to a locomotive was when Eastwick & Harrison, in 1835, built the "Samuel D. Ingham" for the Beaver Meadow Railroad, now a branch of the Lehigh Railroad.

John Scotti, one of the pioneer locomotive engineers of the Baltimore & Ohio, claimed that he invented a locomotive cab which was applied in 1837 to the engines Traveler, American, and Antelope. Mr. Scotti claimed to have effected important improvements upon the locomotive whistle and to have invented the copper-wire joint that came to be universally used.

We had repeatedly heard the claim made that the first cab applied to a locomotive was on the Boston & Albany Railroad, so we made inquiries several years ago. We then learned that in 1839 an engineer named Ellis applied a crude cab to the engine "Tartar," and consisted of corner posts covered with canvas. The invention proved popular among the enginemen, and the modern cab was soon developed from that primitive arrangement.

General Foremen's Department

The Efficiency of Men.

There is a great deal written about the efficiency of foremen, general foremen, and so on up higher, but we hear very little about the efficiency of the men lower down, or, in other words, the great army of mechanics and laborers.

The tendency of our superior officers seems to be towards gradually depreciating the value of a man with a good trade, as he is required less and less to think for himself. This is where the trouble comes, the wage earner instead of advancing himself mentally, is certain to take advantage of the labor-saving machines and systems without ever realizing that he is putting himself in a position that some one else with less training, and consequently less pay could easily fill.

The labor unions are working earnestly to increase wages and better working conditions, but, so far as the writer knows, they are doing nothing to raise the standard among men, and thus have absolute proof that wages should be higher.

A first class machinist is in most cases worth more than he is receiving, but instead of conscientiously applying himself, and continuously adding to his store of knowledge by study, he is more apt to try to perform duties that are, in his estimation, commensurate with his rate of pay. This is certainly the wrong way to proceed. If a man is getting 35 cents per hour, and thinks he is worth more, he should go ahead and do his utmost to prove by his work that he is worth more, and in the great majority of cases the men over him will take notice of his ability, and some promotion will result.

Any of you can recall the men you have known who were well posted, steady, energetic, and really ambitious, and sooner or later they have been rewarded to some extent, at least. If each individual would make up his mind to devote all of his energies to his chosen profession, it would in a short time be surprising how the general average would be raised. It is certainly no hardship for an individual to try and do more than he is being paid for, as this is what puts you in line for promotion, and only a selfish motive should be enough to inspire this.

As was stated before, a first-class mechanic is worth more than he receives in the majority of cases at the present time, but there are so many men that are worth less that a happy medium between the two has to be found. Why not, by individual effort, raise the standard so we can all be first-class men, capable of commanding the highest pay? There are so many apprentices in all trades that secure a "job" as a journeyman before finishing their time, and stop endeavoring to learn more, that the country is getting overstocked with second and third-class men. If each man that is serving his time or has served it at any trade would decide that, purely for personal reasons, he was going to stop working along in a rut, take an active interest in his work while on duty, and study while off, he would most assuredly benefit himself, as has been proved all along with the small percentage that have done this.

What is true of individuals is also true of a number of individuals, so if each individual makes himself more valuable to his employer, his class as a whole will be more valuable, and hence receive more remuneration and better conditions generally.

It is a pretty hard proposition to convince a great many people that an argument like this appeals personally to them, so let's look at it from the most practical standpoint imaginable.

Here is a young man who has finished his apprenticeship and is, we will say, receiving $15 per week. He is considered as good a mechanic as the general run. This man is a good, steady worker, but takes no special interest in his work, and when off duty is wasting his time on some kind of frivolities, and, of course, his money also. What is there in the future for him that is inspiring? Absolutely nothing, except a continuation of this monotony, and never any degree of independence.

Apply our plan now and note carefully the difference. He goes to work in the morning not through mere habit, but because he feels that there is something he wishes to accomplish that day. All work he does is done correctly; any difficulties that arise he makes an effort to overcome it with his own resources without simply asking someone for information. He notices his fellow workmen, mistakes they make, and so on, and guards against them himself. He watches the conduct of his foreman and sees what he does in certain cases, and trys to imagine himself in the same position, and what he would do. He is aware of the fact if the master mechanic comes through, not because he is about to be caught loafing, but because he is alert and knows what is going on about him. Observation is really as great a teacher as experience.

When this young man goes home he makes himself neat and presentable, reads the newspaper and has supper. Then there are from two to four hours before bedtime. He gets books and magazines pertaining to his line of work, and reads and studies, or perhaps had some job today or knows of one for tomorrow that he needs some enlightenment on, and he looks it up.

Of course, a certain number of evenings are devoted to pleasure or any legitimate recreation. He finds that by staying at home and going out only occasionally that there is a real pleasure in getting out and meeting acquaintances, and also that his money seems to last longer. The consequence is, he is making himself more efficient, morally, mentally and physically; is attracting the attention of his superiors; is putting money in the bank. In other words, he has made a start on the road to success instead of on the road to failure, or the one of neutrality, which is about as bad. It is not long before he realizes that he is honestly worthy of promotion, and not long before his hope is realized. Then he must exert still more effort and devote still more time to advancing himself, and continued success is assured.

There are a few who are doing this, but such a small percentage. Let all decide that as individuals they are determined to become more efficient, and in a few years you will not only have bettered yourself, but all in your class, as the success of individuals of a class means the success of the whole body.

Atlanta, Ga. R. S. Booth.

Telephone Dispatching.

The New York, Westchester & Boston Railroad, a new road, not yet complete, from New York to White Plains, but which will be operated from 11,000 volts single phase electric current, will dispatch its trains by use of the telephone instead of the telegraph. This method has been used before, but this is the first time in connection with high voltage alternating current. In order to eliminate the effect of the high voltage on the telephone wires, known as induction, the wires will be placed in underground conduits instead of being carried on poles.

Book Tools.

Many young railway mechanical men—firemen and apprentices—are inclined to be too practical. They think that the only way they can learn about the work they are engaged upon is by doing it. They ought to know that a valuable part of every occupation is its science. Mr. F. W. Taylor, author of "Scientific Management," proves that there is a scientific way of doing everything, even in the loading of pig iron.

It is a fact that books are as much tools of an engineer as a file or chisel. Books, however, are of no use unless they are intelligently and understandingly used. It is a fact that too many young men purchase books with a vague expectation that a book itself will in some way impart its information to the possessor, without mental exertion on his part. They take up a book on, say, applied mechanics or on steam engineering, look into a few pages, fail to become interested, and throw the work aside, thinking they may take it up some other time, and that is the end of it. Knowledge cannot be acquired in that fashion. The desire to learn ought to be coupled with the determination to conquer. When he meets a difficult passage, the right way is to stick to it until it is understood. That is the way self-made engineers become masters of the useful knowledge relating to their business which pushed them upwards.

When a young man first tries to fire a locomotive or do the work in a machine shop, he finds the work very distressing, but if he is made of the stuff that builds success, he keeps on and the fatigue wears away. If similar grit and perseverance are experienced in efforts to take useful information out of books, there will be no danger of failure.

Federal Employers' Liability Act Sustained by Supreme Court.

The Federal Employers' Liability Act of 1908, which some State courts have seen fit to ignore, has been sustained by a decision of the Supreme Court, rendered on January 15. The court declared that this law superseded all State statutes on the same subject, and that State courts must assume jurisdiction, where redress is sought through them, whether the Federal statute seems to conflict with a law of the State or not.

In particular the decision of the Supreme Court takes sharp issue with the Connecticut Supreme Court of Errors in its denial of its own jurisdiction over litigation under the Federal statute. Simeon E. Baldwin, now governor of Connecticut, was chief justice of that court when the case arose, and the decision of the high court today comes as belated justification for Colonel Theodore Roosevelt in his extended epistolary correspondence with Mr. Baldwin in regard to his ruling when Mr. Baldwin was running for the governorship.

"True," says today's decision which was handed down by Justice Van Devanter, "prior to the present act the laws of the several States were regarded as determinative of the liability of employers engaged in interstate commerce for injuries received by their employees while engaged in such commerce. But that was because Congress, although empowered to regulate the subject, had not acted thereon, and because the subject is one which falls within the police powers of the States in the absence of action by Congress.

"The inaction of Congress, however, in no wise affected its power over the subject. And now that Congress has acted, the laws of the State, in so far as they cover the same field, are superseded, for necessarily that which is not supreme must yield to that which is.

"The suggestion that the act of Congress is not in harmony with the policy of the State, and, therefore, the courts of the State are free to decline jurisdiction, is quite inadmissible, because it presupposes what in legal contemplation does not exist. When Congress, in the exertion of the power confided to it by the Constitution, adopted the act, it spoke for all the people and all the States, and thereby established a policy for all. That policy is as much the policy of Connecticut as if the act had emanated from its own Legislature, and should be respected accordingly in the courts of the State."

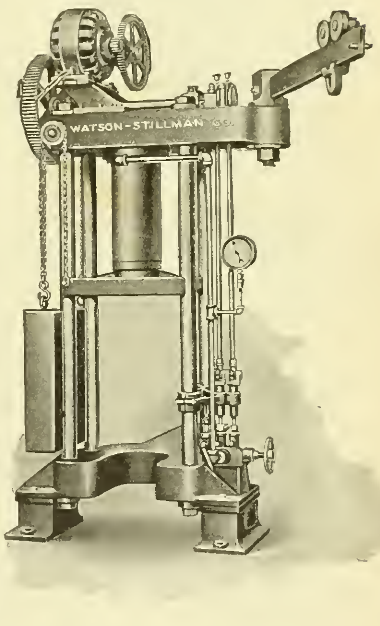
To Remove Rust.

Rust may be removed from iron by immersing the piece for several days, or until the rust has entirely disappeared, in water to which a little sulphuric acid has been added with a piece of zinc firmly attached to the iron so that it makes a good contact. The iron is not attacked as long as the zinc remains in contract with it.

Iron or steel may be cleaned of rust by the use of the following: 100 parts tannic chloride dissolved in 1,000 parts water. Add to a solution containing 2 parts tartaric acid dissolved in 1,000 parts water. Add to the mixture 20 cubic centimeters indigo solution diluted with 2,000 parts of water. Clean the metal parts of all grease, apply the solution to the stained portions for a few seconds, rub clean with a moist cloth then with a dry cloth, and if desired then use any good metal polish. Old rust may be removed in some cases by rubbing with a paste consisting of equal parts of fine Tripoli and flowers of sulphur thoroughly mixed with olive oil.

A Convenient Hydraulic Locomotive Box Press.

The press which we illustrate herewith was designed for Mr. F. F. Gaines, superintendent of motive power of the Central Railroad of Georgia, and has proven very successful for pressing journal box bearings into and out of place. This press is also useful for broaching, key-seating, putting gears on shafts, pressing bearings, handling mandrels and general railroad shop work where heavy pieces are to be forced together. A crane bracket and beam are extended from one end so that the work may be swung into the press without any hard manual labor. A



back-geared motor mounted upon the pedestal on top of the press drives the pump shaft. Upon the other end of this shaft are two pump eccentrics. The pump pistons are both ¾ in. in diameter by 2-in. stroke, and the pedestal legs act as reservoirs for the pump. The operating valve shown is a single screw stem valve which releases the pressure from the work when open, and starts the ram down when closed. A safety valve is used in connection with the pump to stop dangerous overload. The press is made in two sizes, 60 and 100 tons' capacity, respectively, and is also furnished hand or belt-driven if desired. This press is built by the Watson-Stillman Company, of 50 Church street, New York.

It can be applied to a great many shop purposes. Will prove a labor-saving tool.

Questions Answered

DISCONNECTING MAIN ROD.

131. N. S. T., Memphis, Tenn., writes: Where breakages occur rendering a blocking of the valve necessary, is it the best practice to disconnect the main rod, or is it equally safe to leave the main rod attached and proceed with one side of the locomotive working? A.—If it is convenient to remove the main rod it is, with every kind of locomotive, safest to remove the main rod. In the case of the largest class of locomotives where the rods are of great weight and it may be a matter of serious difficulty to remove the main rod, the chief question is a matter of lubricating the cylinder because pistons heat rapidly when running dry. The matter of compression should also be provided against by opening or removing the cylinder cocks. The lubrication of the cylinder is not so easy, and in the case where there are no relief valves, the cylinder head may be loosened and oil injected into the cylinder in a sufficient quantity to preclude the possibility of heating or cutting for at least twenty miles. The problem is one that depends on the size of the locomotive, the appliances at hand, and the facility with which the cylinder may be lubricated.

BLOW IN BY-PASS VALVES.

132. L. M. B., Paducah, Ky., writes: How can a blow in the by-pass valves be detected from a blow in the valve packing in a piston valve engine? A.—The best method is to place the valve on the center of the valve seat so that both ports would be closed, and in the case of the valve packing being defective there would be a blow of steam up the smokestack when the throttle is opened. In the case of a leak in the by-pass valve so that steam reached one end of the cylinder, there would be a blow from the cylinder cock at that end. If the steam leaked from one end of the cylinder to the other there would be a blow from both cylinder cocks, but in the case of the valve having inside clearance the leaking steam would blow up the smokestack in both cases. Hence it is difficult to distinguish with certainty the cause of certain leakages of steam without examination of the suspected parts.

TEMPERATURE OF STEAM.

133. J. T., Collinwood, writes: What variation is there in the temperature of steam from the time that it passes through the throttle valve until it passes out at the tip of the exhaust pipe? A.—It depends in both cases on the amount of pressure. At 180 lbs. per sq. in. of pressure the temperature of steam is 380 degs. Fahr. After passing through the cylinders and reaching the exhaust pipe the pressure might not exceed 5 lbs. per sq. in. gauge pressure. The temperature would then be reduced to 228 degs. Fahr. Most of the standard books on engineering furnish tables showing the variation in temperatures at various degrees of pressure.

CONDITION OF STEAM GAUGE.

134. G. L., Ashtabula, O., writes: When is a steam gauge said to be "light?" A.—When it registers less pressure than the boiler actually contains.

INJECTOR TROUBLE.

135. G. L., Ashtabula, O., writes: 1. Why does an injector work all right after the hot water is blown out of the feed pipe, when it would not work before? 2. What is the cause of an injector not picking up all the water? A.—1. The reason the injector does not prime when the feed water is hot, is because the vapor arising from the hot water destroys the vacuum that must be created by the injector before the water can be lifted. 2. The cause of the water being wasted at the overflow depends upon the make of injector, as, for instance, with the Hancock inspirator it is due to a leaky overflow valve, while with injectors of the Ohio, Monitor or Simplex types, it is usually due to corroded or worn tubes.

SPEED OF PUMP.

136. R. N., Dayton, O., writes: What is the greatest number of single strokes per minute an air pump should be allowed to run? A.—The recommended speed of the 9½-inch air pump is 120 single strokes, or 60 cycles per minute. Some railroads permit a speed of 140 strokes, and while the recommended rate of speed of the large capacity air pumps is about 100 strokes, it is evident that in especially severe service, such as descending heavy grades, it is necessary to run the air pump with a wide-open throttle, and particularly so if steam pressure is low and the maximum brake work is required.

POSITION OF BRAKE VALVE HANDLE.

137. R. N., Dayton, O., writes: Why is it that running position of the brake valve should not be used for releasing brakes, and how long should the brake valve handle be allowed to remain in release position? A.—While this is entirely too broad a subject for a complete answer, we will say that release position is recommended for releasing train brakes because a greater volume of compressed air can enter the brake pipe in this position, and the length of time the valve handle remains in release position depends principally upon length of the brake pipe, leakage in brake system, capacity of the air pump, volume and pressure in the main reservoir, type of brake equipment in use, and whether in freight or passenger service. With the compressed air supply and storage on the modern locomotive, it is generally conceded that 1 second in release position is sufficient in passenger service, while from 5 to 10 seconds is ample time for long freight trains; however, with type K triple valves, about 15 seconds in release position is necessary to get as many triple valves as possible to restricted release position. The short time in relese position is to avoid overcharging the head brakes of the train and a secondary rapid movement to release position is advantageous and sometimes necessary, but you will understand there is very little opportunity for an injudicious use of release position if leakage is about equal to the capacity of the pump, or if pump and main reservoir capacities are insufficient.

PUMP OVERHEATING.

138. R. N., Dayton, O., writes: What causes an air pump to overheat, and what should be done in an event of this kind, and what are the causes of a pump piston making one stroke faster than another? A.—The principal causes of a hot pump are, an excessive rate of piston speed maintained for an unreasonable length of time, lack of lubrication in the air cylinder, gummed up air passages, insufficient lift of air valves, defective or leaky air valves, or leaky piston rings.

In the event of an overheated air pump the proper course to pursue depends somewhat upon the circumstances under which the overheating occurs, and if it is possible to reduce the speed of the pump without incurring the liability of a loss of train control, it should be done, and in all cases the air cylinder should be kept well lubricated.

When the piston rod moves faster in one direction than in the other it indicates a defective air valve or a partly closed air passage, provided that there is no blow through the steam portion, but in the large capacity air pumps the uneven stroke is sometimes due to defective air piston packing rings.

DEAD ENGINE FIXTURE.

139. G. L., Ashtabula, O., writes: In what way can the E. T. equipment be arranged so that a dead engine can have a brake when it is without a dead engine fixture? Could a signal reducing valve be used with the cut-out-cock toward the drum pipe? A.—The signal reducing valve with the adjusting nut slacked off could be used as you suggest for a temporary arrangement to charge the main reservoir on a dead engine until the dead engine fixture can be secured. If an engine without this

fixture fails on the road and is to be hauled in a train, there will be a crew on the engine, and the main reservoir can receive an occasional charge, at opportune times, by opening the brake valve cut-out-cock a trifle and holding the thumb over the brake valve exhaust fitting, but after a charge the brake valve cut-out-cock must again be closed. In the event of an engine without the dead engine fixture failing, should this engine and the one coupling up to haul the train have the train signal equipment, the signal line strainer and check valve on the dead engine could be reversed and the signal hose coupled up, and the main reservoir on the dead engine would be charged to the adjustment of the signal reducing valve on the first engine. On the dead engine the brake valve cut-out-cock would be closed as usual, and the safety valve of the distributing valve adjusted according to the standard practice.

LEAKY CHECK VALVE.

140. W. H.W., Joliette, Canada, writes: What will be the effect of a leaky check valve in a K2 triple valve during a service application of the brake? A.—It will have no effect whatever, as brake pipe air passes under the check valve into the brake cylinder during a service application. However, after a service application or reduction has passed the point of equalization between the auxiliary reservoir and the brake cylinder, a leaky check valve will permit brake cylinder pressure to pass the emergency valve seat and check valve and flow into the brake pipe resulting in a loss of brake cylinder pressure, and if the brake pipe pressure is entirely exhausted the leaky check valve will leak this brake off.

AMPERES AND VOLTS.

141. L. M., Boston, Mass., writes: Please explain what is meant by "ampere," "volt" and "watt." A.—Electricity flowing in a wire is analogous to water or steam flowing through a pipe. In the pipe we have a certain number of units, say cubic inches per minute, and at a certain pressure in pounds per square inch. So in the wire carrying electricity there is the volume in terms of the electrical unit, known as the "ampere," at a pressure in terms of a unit called the "volt." Increasing the pressure in the pipe increases the flow of water or steam, and the same is true with electricity. When the voltage is increased the current or amperes is increased proportionally. At the same time that this comparison is made, we must keep in mind that in the case of the water or steam we are dealing with a concrete thing, while electricity is only known through what it is capable of doing. What electricity is we do not know, but we do know that it can run motors, heat up filaments for lamps, etc. As the power obtainable from the water in the pipe is equal to the product of the amount and the pressure, so with electricity; the power is equal to the volts multiplied by the amperes, and this power we call "watts." For instance, if we have 100 amperes at 10 volts flowing in the wire, the power will be $10 \times 100 = 1{,}000$ watts or one kilowatt. (Kilo means one thousand.) There would still be the same power if there were 10 amperes flowing at 100 volts, as the product is still 1,000 watts. For comparison with mechanical energy, 746 watts are equivalent to 550 foot pounds per second, or one horsepower.

Wants Full Train Crews.

An extract from the Annual Message of Governor Wilson of New Jersey reads: "We have done much toward securing justice and safety for the workingmen of the State in our factory laws, our tenement-house legislation, and our Employers' Liability act, but we have not done enough. Our workmen very justly demand further legislation with regard to the inspection and regulation of factories and work shops, and I recommend legislation of this kind to your very careful and earnest consideration. I recommend, moreover, the passage at an early date of an act requiring the railways operating within this State to provide their trains with adequate crews. Our sister State of Pennsylvania has adopted legislation of this kind, and the railways whose lines cross from Pennsylvania into New Jersey actually carry full crews to the border of this State, and then send their trains on through New Jersey with diminished crews, to the jeopardy, as I believe, of life and property; requiring more of the small crew than it can safely and thoroughly do."

To Promote Safety.

Mr. Darius Miller, president of the Chicago, Burlington & Quincy, is taking a prominent part in the organization of a department of safety on the system he is connected with. The salient part of a circular to employees which he issued recently, reads: "It is very plain to those who have the duty of investigating injuries to persons that a great many of them are entirely unnecessary, and would not have occurred if proper precautions had been taken. The object in sending this personal letter to you is to solicit your interest in the matter of preventing personal injuries of every character, and to secure your earnest co-operation with the local committee which will be formed in your territory. I hope you will inform yourself regarding your committee and support its work. This you can do in large measure by avoiding all unnecessary risks in your own work and using all possible care to avoid injuries to yourself or your co-employees. The company will continue its efforts to reduce and remove, as far as possible, the elements of danger that may surround your work, and you can assist it by reporting to your superior officer conditions of ways or structures that appear to threaten injury, dangerous methods of work that can be improved, or careless employees whose conduct is likely to produce injury to themselves or others.

"If every employee on the Burlington will respond to this request for co-operation and assistance, we believe that by the exercise of greater care on the part of employees, and the provision of better safeguards on the part of the company, a very large decrease in the number of injuries can be accomplished, and much pain, unhappiness and loss of time on the part of employees and others can be avoided."

Difference in Cost of Repairs.

A resolution has been introduced in Congress by Representative Ayres, of New York, calling upon the Interstate Commerce Commission to investigate the repair shops of the railways belonging to the Trunk Line Association. It is declared that the differences in the cost of various things made by railways in their shops vary so greatly as between the shops of different roads that an investigation is needed. Railways are reporting higher costs for repairing cars and engines, yet the workmen in the shops do not see any benefit from the increase. From what we have noted in visiting different railroad repair shops, we have concluded that the difference in cost of repairs is due principally to the difference in tools and equipment. Inferior tools make repairs costly.

The Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., has received an order for the complete equipment of three rotary converter sub-stations and one transformer sub-station from the Kansas City, Clay County & St. Joseph Railway Company. The transformer junction station will contain three 750 kva., 25 cycle, 6,600-33,000 v. transformers. Each rotary converter sub-station consists of six 185 kva., 25 cycle transformers, 33,000 v. primary to rotary converter secondary voltage, and two 500 kw. 25 cycle, 1,200 v. direct current rotary converters. The road runs from Kansas City, Mo., to St. Joseph, with a branch from Kansas City to Excelsior Springs, with a total mileage of 80 miles.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances.

Published Monthly by

ANGUS SINCLAIR CO.

114 Liberty Street, New York.

Telephone, 746 Rector.

Cable Address, "Locong," N. Y. Glasgow, "Locoauto."

Business Department:

ANGUS SINCLAIR, D. E., Prest. and Treas.
JAMES KENNEDY, Vice-Prest.
HARRY A. KENNEY, Secy. and Gen. Mgr.

Editorial Department:

ANGUS SINCLAIR, D. E., Editor.
JAMES KENNEDY, Managing Editor.
ALLEN G. WOOD, Consulting Engineer.
GEO. W. KIEHM, Associate Editor.
A. J. MANSON, Associate Editor.

Western Representative:

J. A. CASSELL, 127 No. Dearborn St., Chicago, Ill.

Boston Representative:

S. I. CARPENTER, 643 Old South Building, Boston, Mass.

London Representative:

THE LOCOMOTIVE PUBLISHING CO., Ltd., 3 Amen Corner, Paternoster Row, London, E.C.

Glasgow Representative:

A. F. SINCLAIR, 15 Manor Road, Bellahouston, Glasgow.

SUBSCRIPTION PRICE

$2.00 *per year,* $1.00 *for six months, postage paid in the United States, Canada and Mexico. For other parts of the world,* $2.50, *or ten shillings. Single copies,* 20 *cents. Remit by Express Money Order, Draft, Post Office Order or Registered Letter.*

Mailing address can be changed as often as necessary—always give old and new address, and if you subscribe in a club, state the name of the agent.

Please give prompt notice when your paper fails to reach you regularly.

Entered at the Post Office, New York, as Second-class Mail Matter.

Power Transmission.

The transmission of power as well as the method of producing the power to be transmitted, have both undergone drastic and progressive changes within the last few years, always with the one paramount and commendable idea of getting the most good out of the least number of dollars.

Motor-driven machines are without doubt rapidly gaining favor, but for many years to come, the good old leather belt will be in evidence.

Dr. Angus Sinclair in a recent address, touching upon the origin and development of the lathe, mentioned the historic "lath" as being run by means of an overhead spring lever or "lath," to which was attached the power transmitter in the form of a strap or belt, and very few if any shops in the present day are free from belt troubles, even though they may be equipped with a majority of motor-driven machines.

This article does not intend to treat of belting in all of its ramifications—cotton, rope-drive, treated duck and rubber—but purposes to mention some facts in relation to leather belting which may be of help to our readers.

We will not dwell upon the many cheating methods employed in selling leather belting, nor upon the various ways to discover these misrepresentations; the best and surest way to get good belting is to buy from a reputable concern; order the best and pay the price. The leather market is published in most daily papers and good belt leather in the rough usually weighs about one pound to the square foot.

In tanning a belt hide, the tan bark (usually oak) is ground and put into a vat, known as a leach, and water sprinkled over it, percolates through the bark and is drawn off at the bottom. This percolating process is carried on under various conditions until a liquor is obtained suitable for the purpose intended, the liquors obtained from the various "runs" being of greater or less strength.

Some belt makers use these liquors as they are first produced, and others use a concentration called "extract," either method allowing for dilution to suit the tanner.

Extract must not be confused with chemical "acid tan," as acids or other chemicals could be added to any mixture if the tanner so chose.

There is also a process known as mineral tannage which has a great many advantages for special purposes.

A belting "Butt" is cut from the center of the hide, the length and width depending upon the size and thickness of the hide, the best leather extending along the backbone from just back of the neck nearly to the tail. The side strips are usually of nearly equal quality, but lighter weight. The neck pieces are usually made up into double belts and if not "spongy" are fairly good. The remainder of the hide is usually cut up for "agricultural belt" and straps.

The joints or "laps" of first-class belting are made with cement, which in these modern days holds the pieces together under all conditions and the use of rivets is not recommended.

Every shop should be provided with belt clamps, cement and a belt plane, in order that belts may be repaired or "taken up" easily and cheaply.

A belt intended for "quarter turn" or "cross belt" should be cut upon a curve and then when properly applied will lay smoothe upon the pulleys. A belt for any special purpose should be ordered for that particular service and the result will be well worth the trouble.

Where a stock of belting is carried (and it is better if seasoned) arrange to have it near but not upon the floor. A very convenient belt rack is made by suspending iron pipe in convenient notched frames, the iron going through the center of the roll of belting, enabling the belting to be pulled out (unwound) to any desired length.

Do not have your belt stock in a damp place, nor yet a very dry one, a moderate temperature in a room away from the ground is best suited to this purpose.

In cutting belting use a try-square and awl to mark it, and then cut it with a harness makers' knife, similar in appearance to the ordinary household chopping knife.

To accurately compute the required length of a belt, add the diameters of both pulleys over which the belt is to run and multiply this result by 3.14159 (approximately 3¼), divide this result by two and to this add twice the distance between centers (centers of the shafting). This final result is the length of the belt required to go around both pulleys and meet "butt ended." An allowance should be made in addition for the lap to be cemented.

In looking over a stock of belting, it is frequently desirable to ascertain the number of lineal feet in a roll. If the belting is closely rolled, measure the diameter of the roll and to this add the diameter of the hole or opening in the center of the roll, now multiply this sum by the number of coils in the roll and this result by .131, which will give the length of the belt.

To ascertain the horse power which a belt is capable of safely transmitting. First multiply the diameter of the driving pulley in inches by its revolutions per minute and this result by the width of the belt in inches. Then for single leather belts divide this final result by 3,000. If the belt is a double leather divide by 2,100, and the results are the horse power transmitted.

Single leather belting, four-ply rubber belting or four-ply cotton belting, have about the same tractive power and either one when not overloaded, one inch wide running 800 feet per minute delivers approximately one horse power.

To find what would be the necessary diameter of a driving pulley to drive a pulley of known diameter at a given speed. Multiply the known diameter of the pulley to be driven by the number of revolutions desired and divide this product by the number of revolutions made by the shaft which is to carry the driving pulley. The result is the diameter of the driving pulley.

To find the number of revolutions a driven pulley is making. Multiply the diameter of the driving pulley by its

own number of revolutions and divide the product by the diameter of the driven pulley. The result is the number of revolutions of the pulley being driven.

When it is desired to drive a shaft at a given number of revolutions per minute, and a pulley is already on the main line shaft, multiply the diameter of the main line pulley by the number of revolutions of the main line shaft and divide this product by the number of revolutions desired on the counter or jack shaft. The result is the diameter of the pulley required to be driven.

To ascertain the speed at which a belt is traveling, multiply its circumference (total length) by the number of revolutions of the shaft. The result is the speed of the belt in feet per minute.

Keep your belts in condition. If considerable oil is unavoidable, wipe off the belts when they "sweat," but not when they are running (on account of possible accident). If they are dry use a reasonable amount of belt dressing, preferably a dressing made by the same manufacturer that made the belt.

Undoubtedly the wood working shop is the most severe on belting. Here the belts should be brushed off thoroughly each night and belt dressing used very sparingly about once a week.

Last comes the ever present argument as to the best method of applying a single leather belt—whether with the grain side or the flesh side to the pulley. Those who learned their trade under the regime of the old blue laws will remember that the "old man" used to say "put the grain side out, for that's the way the critter wore it." Modern practice seems to favor the grain side to the pulley and yet a good mechanic recently advanced the theory that the flesh side, if properly curried and dressed, would hug tighter to the pulley, and ergo, obviate to a large extent the slipping which would naturally occur when the grain or hard side was next the pulley.

There used to be a saying that to turn a steel shaft true it was necessary to squirt tobacco juice upon it, but we are in doubt about this also, and therefore will be obliged to leave these much mooted questions to the tender mercies and mature deliberations of the other mythological enigma, the "Stove Committee."

Service on Railways.

It is sometimes considered to be a singular circumstance that while wages in the building trades are higher than those paid to the average railway man there is a constantly increasing number of applications for positions in railway service. It is a proof that the mere question of wages is not the only element that attracts the best class of young men. The assurance of steady employment enters largely into the minds of the thoughtful class that seek service on railways. This is wise in more ways than one, for apart from the mere reward of labor there is nothing that so completely fills up the measure of human existence as constant employment, that is, if the labor is not too exacting and the hours are not too long. There is also, generally speaking, a variety in railroad work which adds to the pleasure of doing it.

To the healthy, active man, clear of brain and sound in body, idleness is misery. Not only so, but it begets other evils. Working men, especially in the building trades, are apt during their unemployed periods to frequent resorts and contract habits that have a pernicious effect on their lives. Some young men there are who, starting out in life, look upon toil in any form as a necessary evil to be evaded if possible, and borne grudgingly if it cannot be avoided. Envy of the rich occurs only to those who have had a narrow view of life. Those who have had opportunities of meeting the rich and seeing at close range the shallow, frivolous lives that many of them lead are not stricken with envy. The rich are not all of that kind, but as a class they know little of the substantial satisfaction that comes to the clear-minded working man who takes a pride in his work and whose daily tasks are ennobled by the unselfish efforts and self-sacrifice that look to the welfare of others who may be depending upon him.

The railway service is largely composed of men of this kind. The regularity of their occupation induces a sober and intelligent regularity of life. The danger attendant on their work begets a seriousness well calculated to develop the highest qualities of good citizenship. There is a charm in regularity, and a pride in harnessing the titanic forces of nature to a good and useful end, and the necessary diversity in each day's work makes railroading attractive. These are some of the reasons that make railroading alluring. It is not only surprising to see and know that a constantly increasing number of railway employees own their own homes, but, what is perhaps better, they take special care in the education of their children and thereby not only give a good example of a life well spent, but lay the foundations of the improved future well-being of the communities in which they live.

It is also particularly gratifying to observe that the facilities for the better training of railway men are being taken advantage of more fully than heretofore, with the result that a larger degree of perfection in mechanism is adding to the comfort and safety of the general public and consequently adding to a higher and nobler national life.

The Fellow-Servant Iniquity Going.

In these pages we have many times denounced the injustice of the old common-law rule holding that the negligence of a fellow servant absolves employers from responsibility, and we are glad to see that our Supreme Court judges and others having authority are taking a fair view of such cases. Governor Baldwin of Connecticut is a conspicuous exception, and advocates the application of the vicious common-law rule, a fact which should be remembered by railway men; but the rule has long been reversed at the bar of public opinion, and is now being rapidly reversed by the courts. The United States Supreme Court has sustained the validity of a statute of Arkansas which makes coal and railway companies responsible for damages to employees who suffer from personal injuries due to the negligence of fellow servants. Justice Martin, of New Jersey, has rendered an opinion sustaining the validity of a statute of similar import to that of Arkansas, and cites Justice Hughes, of the United States Supreme Court, as follows:

"In dealing with the relation of employer and employed, the Legislature has necessarily a wide field of discretion in order that there may be suitable protection of health and safety, and that peace and good order may be promoted through regulations designed to insure wholesome conditions of work and freedom from oppression."

There are many good illustrations of the injustice imposed by railroad companies upon their employees through the iniquitous fellow-servant ruling of the common law. For instance, a car repairer on the Missouri Pacific having been injured, while at work under a car, through the failure of his foreman to prevent the car from being struck, a verdict for damages was obtained in a district court as the railroad company appealed to the Supreme Court, which sustained the verdict of the district court.

The workman had gone under a car to affect repairs, depending upon his foreman to protect the car from being touched, but the foreman had asked a yard man to see to the protection of the car, but he had neglected to do so, and a switch engine bumped the car, causing the workman to be injured. The employers tried to sneak out of responsibility by pleading the fellow-servant plea, but the court held that the foreman was responsible for the accident and that he was not a fellow-servant.

Every railroad company that tries to sneak out of responsibility does more to prejudice railroads with the public than do the raving of anti-railroad agitators.

Book Reviews

The Early Motive Power of the Baltimore & Ohio Railroad. By J. Snowden Bell. New York. Angus Sinclair Company. Price, $2.

The Baltimore & Ohio Railroad holds the same position in relation to land transportation on the American continent that the Liverpool & Manchester Railway holds to railway construction in Europe. It was the pioneer, and the art of railroad building with the art of designing and building railroad motive power and rolling stock were developed by the men who worked on the vast achievement of putting this great railroad into operation. The building of the railroad and its equipment formed a school from which other railroad pioneers learned their business.

The story of the designing and constructing of the first motive power of this railroad is well worthy of being preserved, and there is no living man so capable of telling the story as J. Snowden Bell, author of this volume. Mr. Bell claims no more credit for the work done than that of a compiler, but he is the kind of compiler who displays a keen memory for details and accuracy of description that are surprising in telling of things that have long passed away.

The book gives excellent descriptions and admirable illustrations of the pioneer locomotives, but it does more, for it constitutes a good history of early railroad development in the United States, and of the influence the property exerted all over the country.

The directors of the country published excellent annual reports giving full particulars of the operations carried on during the year. The *American Railroad Journal*, commenting on one of these reports, said: "We cannot refrain from expressing our own and the thanks of the whole railroad community, as well in Europe as America, for the candid, business-like, liberal manner in which they annually lay before the world the result of their experiences. It will not be saying too much to denominate them the Railroad University of the United States."

Mr. Bell follows the growth of the locomotive from Cooper's "Tom Thumb" to the modern Mallet, and notes many of the engineering problems that were settled during the construction of the Baltimore & Ohio Railroad. Among these were details of roadbed and rail fastening, curvature of track, steepness of grades, dimensions of locomotive details, and designs of cars, both for passenger and freight service.

One thing which the book brings out clearly is, that American railway machinery was worked out on original lines by men capable of inventing every detail from a screw thread to a boiler. The mechanical part of the book is admirable, printing, engraving and binding being first-class in every particular. No one will grudge paying two dollars for this handsome book.

Report of the Proceedings of the Forty-fourth Annual Convention of the American Railway Master Mechanics' Association, held at Atlantic City, N. J., June 14-16, 1911. Published by the Henry O. Shepherd Company, Chicago. 516 pages, with illustrations. Cloth. Price, $1.50.

The appearance of the annual report of the proceedings of the Master Mechanics' Association is becoming a matter of much interest among the leading railway men. While the engineering press has done good work in the way of reflecting an epitome of the work of the association, it remains for the annual volume to present in detail not only the reports of the various committees, but the interesting debates to which the reports gave rise. The volume before us is of much value as touching upon many of the unfinished problems in railroad work in a way that can only be done by those who are actively engaged in railroad work and have opportunities of observing at close range the improved mechanical appliances that have tended and are still tending to make the subject of railroad transportation the most interesting, as it is the most vital commercial feature of our time. To the many leading railroad men engaged in the mechanical departments who could not make it convenient to attend the meeting which the book so fully describes, we would advise them to secure a copy and so keep informed of the important work of this important association.

The Walschaert and other Modern Radial Valve Gears for Locomotives, by W. W. Wood. Published by the Norman W. Henley Publishing Company, New York. 245 pages. Fully illustrated. Cloth. Price $1.50.

A third edition of this popular book has been issued with important additions that greatly enhance the value of the work. We have frequently called attention to the merits of the earlier editions of this work, and it is gratifying to observe that the demand for the book has been such that the enterprising publisher has issued a new and larger edition. Of the new matter, the most important is a full description of the Hobart-Alfree and the various forms of the Baker-Pilliod valve gearings. The rapid adoption of the outside kinds of valve gearing is such that it becomes every railroad man engaged in the mechanical department who is brought in contact with the modern locomotive to familiarize himself with the details of these important improvements. Mr. Wood's style is admirably adapted to the requirements of practical men, while the press-work and illustrations are in Mr. Henley's usually high degree of excellence.

The "Mechanical World." Pocket Diary and Year Book for 1912. Published by Emmot & Co., Manchester, England. 426 pages, with numerous illustrations. 4 ins. by 5¼ ins. Cloth. Price 25 cents.

Young engineers who do not care to secure a copy of Kent's standard work at a high price have in this compact, handy volume an epitome of the larger work that may very well serve their purpose in almost every conceivable emergency. The book is not in any sense strictly a British book. The valuable and comprehensive tables are the universal standards in engineering practice. Probably the most recent new features in this excellent work are the tables on the qualities of saturated and superheated steam, and also a condensed summary of the most recent applications of electricity. The great popularity of the book is the best guarantee of its utility.

The "Mechanical World." Electrical Pocket Book for 1912. Published by Emmot & Co., Manchester, England. 290 pages, with numerous illustrations and diary. Cloth. Price, 25 cents.

This is a companion book to the Mechanical Engineering Annual, published by the same company, and contains a mass of information to electric engineers. The additions this year are largely on the important subject of electric lighting. This subject has been entirely rewritten, so that those who have copies of the older volumes may rest assured that by securing a copy of the present volume they will be in possession of much new matter not contained in the previous volumes. A fine feature of the work of the enterprising publishers is the fact that they invite contributions which, if accepted, are paid for. The entire book has been thoroughly revised.

The Day's Work.

The day returns and brings us the petty round of irritating concerns and duties. Help us to play the man, help us to perform them with laughter and kind faces; let cheerfulness abound with industry. Give us to go blithely on in our business all day long, bring us to our resting beds weary, content and undishonored to enjoy the gift of sleep.

Catechism of Railroad Operation

By Angus Sinclair

QUESTIONS AND ANSWERS.

Third Series.

105. What are the principal dimensions of the locomotive you are firing?

A. The engine is of the Pacific type—that is 4-6-2—with cylinders 22 × 28 inches; driving wheels 72 inches outside diameter; boiler, wagon top style, 66 inches diameter at smallest ring providing 3,539 square feet of heating surface, the grate area being 54 square feet, working steam-pressure 200 pounds gauge pressure.

(These are the principal dimensions of a group of locomotives recently illustrated in these columns.)

106. Are you acquainted with the rule used for calculating the tractive power of a locomotive?

A. I know the rule that reads: square the diameter of one cylinder in inches, multiply the product by length of stroke in inches, multiply that product by 85 per cent. of the boiler pressure in pounds and divide the product by the diameter of the driving wheels in inches.

107. Put that problem into figures.

A. 22 × 22 = 484 × 28 = 13,552 × 170 = 2,303,840 ÷ 72 = 31,998, the tractive power from which 10 per cent. is subtracted for friction.

108. What do you understand the expression tractive power to mean?

A. The power which the engine exerts upon the drawbar to haul a load.

109. Is the whole tractive power of a locomotive exerted in ordinary working?

A. No. The figures given represent the haul the engine would be capable of exerting while starting a train or hauling on a slow heavy pull.

110. When that engine is pulling a heavy train at a speed of 60 miles an hour, about what would be the tractive power exerted.

A. Running at 60 miles an hour, that engine whose drivers are 72 inches diameter would make 284.5 revolutions per minute and would open the ports for steam admission and exhaust 569 times, which would leave about one-tenth of a second for steam to enter the cylinder. Under these circumstances the mean effective pressure, as it is called, inside the cylinder would be about 40 pounds per square inch instead of 170 pounds available in starting. So then the problem of that engine power would be 22 × 22 = 484 × 28 = 13,552 × 40 = 542,080 ÷ 72 = 7.528.8 pounds: As a passenger train running at 60 miles on a level track offers resistance of about 16 pounds per ton of entire train, this engine ought to be capable of moving 470 tons, including the engine and tender at the speed named.

(Figuring out these particulars for engines having different proportions is excellent practice for a person trying to learn the principles of locomotive engineering.)

11. What is reckoned by engineers as one horse power?

A. The power applied in raising 33,000 pounds one foot per minute.

112. How would you calculate the horse power of the locomotive whose tractive power has just been demonstrated?

A. By the following process:

380.15	square inches of piston area of one cylinder.
40	pounds mean effective pressure on piston.
15,206.00	
4.66	feet piston travel each revolution.
70,859.96	
2	cylinders.
141,719.92	
284.5	revolutions per minute.
40,318,317,240 ÷ 33,000 = 1,221	horse power developed.

113. What work about his engine is an engineer expected to do?

A. Inspect the engine thoroughly before and after each trip. In case of any parts becoming loose during a trip would tighen them up. Would adjust the wedges, keep the rods properly keyed up, pack oil cellars and keep the headlight in good order.

114. How should the work of setting up wedges be done?

A. That work should be done when the engine is under steam and the wedges should be adjusted tight enough to prevent the box from knocking, but loose enough to permit it to move freely in the pedestals. This is best done by pushing the wedges up tight and then pulling them down sufficiently to relieve the side pressure.

115. How would you proceed to set up wedges?

A. Would block the track wheels to prevent the engine from moving, having previously placed the engine on the upper quarter of the right hand side. Would then admit a little steam and drive the boxes hard away from the wedges. After doing that would go under the engine and put up the wedges tight with a wrench, and make a side scratch on the pedestals at top of the wedge, then draw them down equally about one-eighth of an inch.

116. How should rod brasses be keyed?

A. The key should be driven down just enough to bring together brass to brass. Any greater force would spring the crown of the brass against the pin and probably cause heating.

117. How should an engine be placed for the purpose of keying rod brasses?

A. That depends upon the rods to be keyed. If the main rod is to be keyed, place the side of the engine upon which the work is to be done, either on the upper forward eighths, or the lower back eighths, as these positions present the greatest diameter of the pin to the rod brass and guarantee a free movement at all points without binding. It should be remembered that crank pins tend to wear oval and that brasses must be keyed at the point of the greatest diameter.

118. How should the side rods on six-coupled, eight-coupled and ten-coupled locomotives be keyed?

A. Would place the engine upon a straight level track on the dead center, either forward or back. Would then key the main connection, leaving it sufficiently free on the pin to be moved laterally by hand. Then would adjust the other connection in the same manner. After this is done, it is a good plan to move the engine to the other dead center to see if the brasses are free from binding position. Before beginning to key the rods it is important to have the wedges properly adjusted.

119. Why should the engine be placed on the exact dead center and begin by keying the main connections?

A. In order to insure keying the rods to the proper length to allow them to pass the dead centers without strain.

120. What is meant by the expression, "engine out of tram?"

A. By engine out of tram, is meant one whose distance from center to center of axle does not coincide with the similar distance on the opposite side of the engine. Or it may mean that the distance between two connected crank pins is not the same as the distance between the two axles to which the crank pins belong. Out of train is one of the most

dangerous conditions of a locomotive and ought to be remedied without delay.

121. What is the necessity for keeping side rods in tram and for keeping the brasses keyed up properly?

A. To prevent unnecessary strain and shock which cause heating of rod brasses and pounding of axle boxes putting unnecessary tension upon the entire motion likely to have disastrous consequences.

122. What is friction?

A. Friction is the resistance to motion offered by the surfaces of bodies in contact in a direction parallel to these surfaces. The action of friction is illustrated in railway work by the operation of brake shoes on wheels to stop trains; the friction between driving wheels sufficiently loaded and the surface of the rails enables the locomotive to exert much tractive force without slipping the wheels. Friction also resists the turning of an axle on its journal and makes tractive force necessary to move a train of cars.

123. Upon what does the amount of friction between two bodies depend?

A. The amount of friction between two bodies in contact, depends on pressure, temperature, speed, kind of material, and the quality and quantity of lubricant used. Friction is nearly independent of the area of surface of an article to be moved. A brick will move as freely on a board or inclined while resting on its side as when resting on its face.

124. What is meant by the co-efficient of friction?

A. The proportion which the resistance to sliding motion bears to the force pressing the substances together. A smooth iron casting loaded to weigh 100 lbs. will require a force of 15 lbs. or 15/100 of the weight to slide the plate upon another smooth plate. The co-efficient of friction is therefore said to be 0.15.

125. What effect has the introduction of oil or other lubricant between rubbing parts?

A. It renders friction in proportion to the quantity and quality of the lubricant used. Tests with different lubricants showed that with tallow the co-efficient of friction was 0.1; with lard oil, 0.07; with olive oil, 0.064; with lard and graphite, 0.055, which proves that the amount of frictional resistance is greatly influenced by the lubricants used.

126. What effect has pressure between the rubbing parts upon lubrication?

A. High pressure between, say, bearing and journal, has a tendency to prevent the lubricant from being efficient. The lighter the load the easier it is to apply lubricants to advantage.

127. What effect has speed upon lubrication?

A. When frictional parts, such as journals, crank pins or eccentrics move at high velocity, lubricating the parts effectually is much more difficult than it is when the speed is low or moderate.

Permanent Exhibit of Railway Appliances.

The International Textbook Company that operate the Scranton Correspondence Schools, have engaged in an enterprise that will interest a great many railroad men. A long felt want has been a place where accommodation would be provided for the exhibits of railway appliances and a meeting hall in a district where hotel accommodation could be provided for a big convention. The people of Saratoga, N. Y., have made several attempts to find the means to provide a convention hall exhibit space, but it has come to nought, and now the International Textbook Company have quietly come forward and provided the accommodation so long desired.

A permanent Railway Exhibit has been opened in the Karpen building, 900 South Michigan avenue, Chicago. In connection with that exhibit there is soon to be a large assembly room that will seat about 600 people. The exhibit room includes a space of 26,000 square feet, which will be divided into spaces to suit the convenience of customers. The spaces rent for $3.50 per square foot, which includes a mahogany desk, table and three chairs, a nice rug and curtains around the booth, water, light, telephone and janitor service. Although the establishment was open only on January 2, about 100 of the spaces have already been taken.

The promoters of this enterprise are doing all in their power to induce all classes of railway men to make the establishment a regular place of call, and the number of visitors who have already registered means "Success" in big letters.

A Strong Locomotive Boiler.

The modern locomotive looks very different from the first forms introduced as railway motive power, but in one respect there is practically no difference in the engine. The boiler and firebox are practically the same as that used in the first successful British and American locomotives, viz.: Stephenson's "Planet" and Baldwin's "Old Ironsides." These engines had a square firebox at the rear of a tubular boiler with inside and outside shell of flat sheets bound together by staybolts. During all the years that have passed since these engines were put into service, succeeding builders have changed the dimensions of the fireboxes, but the flat sheets with the troublesome staybolts have remained unchanged. Numerous innovations have been offered, such as Vanderbilt's tubular furnace, but the motive power officials would have none of them.

Among the substitutes offered to replace the common locomotive firebox have been many freaks that would have been dangerous to use, but there is one form of firebox which seems practical in every way, with features that overcome the weakness of the flat sheets, which ought to receive more favorable consideration than it seems to receive from motive power men. This is the Wood corrugated firebox and tube plate, the invention of a boiler expert, and which have been undergoing the test of hard service for about four years. There are three locomotives belonging to the New York Central Railroad equipped with this combination that have been in service over three years, and prove the value of the invention.

The corrugated firebox sheets neutralize the strains that lead to constant trouble with flat sheets of cracking, breaking of staybolts and leaky mud rings. An invention that eliminates these defects is sure to win in the end.

Durability of Krupp Tires.

The tariff on steel excludes Krupp steel tires to some extent from use on American railways, but there is good reason for believing that the high quality of Krupp steel would make their use profitable in spite of the higher price.

Some years ago experiments were made on an Austrian railway to demonstrate the rotation value of Krupp and of Martin steels. Three wheels on one side of a passenger locomotive were equipped with Krupp tires and three wheels on the other side with Martin tires, the diameter and profiles of all the tires having been exactly alike. When the engine had run 200,000 kilometers (124,000 miles), the tires were carefully examined, and it was found that the Krupp tires had been worn on an average 10 millimeters (about 0.4 in.), while the Martin tires had worn 14 millimeters (about 0.56 in.). Including the weight of the metal removed in again turning down the tires to the normal profile, the weight lost, due to wear, was 40.4 kilograms (88.88 lbs.) in the case of Krupp tires, and 56.4 kilograms (124.08 lbs.) in the case of Martin steel, a steel which is superior to the average American tire steel.

Brass Valves.

Brass slide valves are almost exclusively used on European railways, although they cause greater friction and do not wear so well as cast-iron valves. In this case, as well as in many others, prejudice is more powerful than proof of experience.

Air Brake Department

Wrongly Used Triple Valves.

In the numerous types of air brake equipments in use today there are some parts of a certain type of brake that are perfectly interchangeable with those of another, but many of the parts of every different type of brake cannot be used save with the equipment they were originally designed for.

If the size or construction of a repair part is such that it will not fit anywhere but at the place it is intended to be used there is very little opportunity to misapply the part, and when the mechanical construction permits of an improper application of the part, its intended use is always indicated by some distinctive feature or by a special marking.

Even at this late day, it is necessary to impress upon the minds of air brake inspectors and repair men the necessity of maintaining the standards decided upon by the manufacturers, and when the repair men fail to distinguish the difference in triple valves and their repair parts, it results in wrong repairs, and sometimes the attempted repairs produce a worse disorder than that previously existing.

While we know that conditions in the average car yard or car repair plant are conducive to frequent changes among the employees, it is, nevertheless, some one's duty to see that the proper size and type of triple valve is applied to a car when another is removed.

This matter of using freight triple valves in passenger service and passenger triple valves on freight cars is about the most ridiculous mistake that is being made in ordinary repair work.

This is usually the result of the repairman not knowing the difference between the triple valves, while sometimes it is due to carelessness, and in rare instances it is due to obeying ill-advised instructions.

The deplorable feature of the wrongly used triple valve is that the parties responsible for the wrong repairs rarely, if ever, know what the ultimate effect will be, and we will devote the remainder of this article in an effort to state some of the principal effects of using the wrong valve, confining this to freight cars and the valves that can be applied thereto.

The wrongly used triple valve that is most frequently found is the P 1 in freight service. This valve was formerly known as the F 27, and it is intended for passenger service and for use with 8 and 10-inch passenger car equipments, and should never be employed in connection with freight car brakes, and can be distinguished by the fact that it has but one exhaust outlet, while the freight triple valves have two for convenience in attaching the retainer pipe.

Unfortunately this valve can be bolted to an 8-in. freight car auxiliary reservoir, and on one car alone or on a very short train this valve may apply and release perfectly along with the other brakes, but if the P 1 valve is being operated in ordinary freight service it means that it will result in stuck brakes, slid flat wheels and sometimes failure of brake to apply.

This statement has been disputed, and in several instances heads of departments have been very reluctant to accept the finding of a P 1 triple valve on a freight car as the cause of slid flat wheels. All other parts of the brake equipment measuring up to the standard, and in order that our readers may not be confused in this matter, and to assist them to intelligently back up any statement that may connect the use of a P 1 valve in freight service with stuck brakes and slid flat wheels, we will first consider the charging time of the passenger triple valve as compared with the H 1 or K 1 freight triple valves.

On the modern test rack, which operates with a standard 8-in. freight car reservoir, the charging time of the H 1 triple valve, which is, by the way, the standard size triple valve for this reservoir, is from 0 to 70 lbs. pressure, in from 58 to 78 seconds, brake pipe pressure being maintained at 80 lbs.

The P 1 triple valves' charging time on this rack, and on this same reservoir, is from 0 to 70 lbs. pressure in from 34 to 44 seconds, and it might be well to note at this time that the charging time of the K 1 in this reservoir is from 0 to 70 lbs. in from 100 to 120 seconds.

As the P 1 triple valve charges the reservoir in about one-half the time the H 1 does, it follows that the P 1 valve charges to a higher pressure in the same length of time of charging if it is given the opportunity to do so.

Understanding then that if the capacity of one feed groove is such that it will charge a reservoir to a given pressure in one-half the time required by another groove, it will change the reservoir to approximately twice the pressure when both grooves work for the same length of time, stipulated, of course, that the necessary supply of brake pipe pressure is available, then it becomes apparent that in charging the reservoirs the P 1 valve on a freight car will do twice the work of a proper type of triple valve, or, rather double the work of an H 1 triple valve and do three times the work of a K 1 triple valve when it is in retarded release position.

Now to follow up the effect of this variation in the time of charging when the wrong triple valve is in use, we will assume that one of the head cars of a freight train has a P 1 triple instead of an H 1, and the train is not fully charged when the engine is coupled.

The action of the S. F. governor may necessitate a movement to release position in order to permit the starting of the pump and with modern air pump and main reservoir capacity the use of release position insures 90 lbs. or more brake pipe pressure on the head cars, while the rear cars of a long train are charging, then while the H 1 triple valve on the head end is charging the auxiliary reservoir from, say, 50 to 70 lbs., the P 1 valve will charge its reservoir from the 50 lbs. to about 85 or 90 lbs. and a movement of the brake valve handle to running position and a maintainance of 70 lbs. brake pipe pressure then means an application of the P 1 triple valve and a stuck brake. If noticed and bled off, all is well and good for the time being, but if the train is started with the brake applied in this manner the wheels are not very likely to start to revolving, as a 20 lb. reduction from a 90 lb. auxiliary pressure, with fair piston travel, means about the same brake cylinder pressure as a 20 lb. reduction from a 70 lb. brake pipe pressure, which is sufficient in most instances to prevent the wheels from revolving when the train is started, and if this is not promptly noticed, slid flat wheels will result.

If this freight car brake with the P 1 triple valve should be among the head cars of a train descending a long grade, an overcharged and an overworked brake will eventually result in slid wheels on this car, as release position on the brake valve is intended to be used in heavy grade work, and with proper air pump and main reservoir capacity, a brake pipe pressure of 90 or 100 lbs. will be maintained on the head cars, while the rear car brakes are being recharged, and if the other cars on the head end are equipped with K triple valves a recharge of the head brakes after a 10 lb. brake pipe reduction would give the P 1 valve an opportunity to charge its aux-

iliary reservoir from 60 lbs. to 85 or 90 lbs., while the K triple valves with the uniform recharge feature, are charging from 60 to 70 lbs.

It is then very easy to determine the brake cylinder pressure that will result on this car upon the second application, the brake will start to apply as soon as brake pipe pressure starts to fall, and with the retaining valve holding 15 lbs. in the brake cylinder, a 10 lb. reduction on the K valves will mean a 30 lb. reduction from a 90 lb. auxiliary pressure on the P 1 triple valve, which will give a brake cylinder pressure of about 68 or 70 lbs.

Any movement to running position would then cause a stuck brake even if the high brake cylinder pressure alone could not slide the wheel, and if the speed of this car was momentarily accelerated by the release of other brakes or by any shock in the train, the holding effect of the shoes against the wheels would prevent a sufficient increase in the speed of the wheel tread to move along the rail at the same speed the car body was momentarily moved, and the consequences are sliding wheels.

It will now be apparent to the reader that it requires no special combination of any types of triple valves or any particular manipulation of the brake valve for the wrongly used triple valve to cause trouble, as it cannot work in harmony with other brakes unless it is confined to some particular class of service and placed in some selected portion of the train.

Furthermore, one of the greatest difficulties encountered in grade work is the tendency for the head brakes to do all the work, on account of the ability to recharge them more promptly than the rear brakes; hence the effect of using a triple valve that will recharge two or three times faster than the standard valve, is plainly apparent.

While any movement to release position at any time is liable to cause trouble when a P 1 or P 2 triple valve is in the train, the use of these valves in freight service also affect the application of the brake.

In order to apply the brakes on a train of cars, it is necessary to reduce the brake pipe pressure faster than it can flow from the auxiliary reservoir through the feed grooves and past the packing rings into the brake pipe, and in the middle or just back of the middle portion of long trains the fall of brake pipe pressure during service reductions is so slow as to make the application of brakes in this portion of the train very difficult, and when brakes fail to apply, it usually occurs in this portion of the train, due to the backward flow of air from the auxiliary reservoir, and where the application from this cause is difficult with proper sized triple valves, a wrongly used valve cannot be expected to apply at all, as it can reduce auxiliary reservoir pressure through the feed groove in proportion to the rate at which it can recharge.

Brakes failing to apply under the conditions mentioned has no reference to failure to apply due to brake cylinder leakage or brakes otherwise defective.

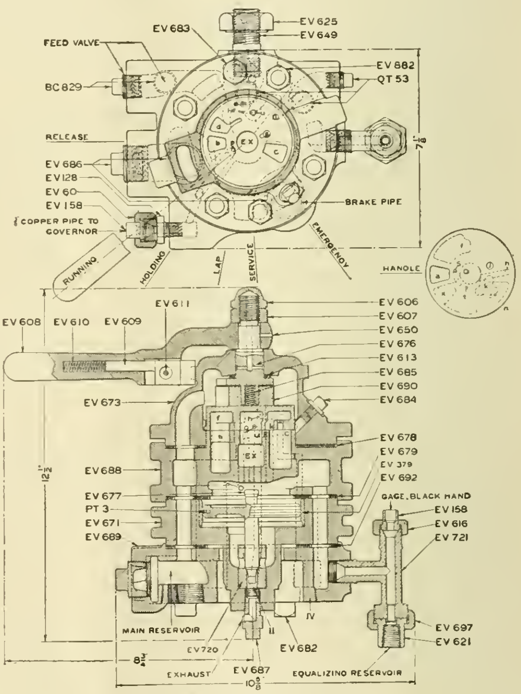
The faulty action of the wrongly used triple valve is not even confined to long trains, as some years ago the writer had occasion to investigate a trouble of brakes sticking on a locomotive tender in passenger service. All the brake apparatus and brake gear under the tender was maintained in a practically perfect condition, and while the brake valve manipulation may have been somewhat faulty, the tender brake was the only one to reapply, and an investigation disclosed the fact that a P 2 triple valve was being used with the 10-in. tender brake equipment. This was made possible by the triple valve being mounted on a special type of bracket instead of the brake cylinder, and when in the shop the wrong type of bracket was applied, and the P 2 triple valve could charge the 12 x 33 reservoir in one-half the time required by the P 1 valve with the resulting overcharge during release accompanied by the stuck brake and overheated wheels.

The P 2 valve is also finding its way into freight service, as it can be bolted to the 10-in. freight reservoir, and its charging time is one-half that of the H 2 valve, or about one-third that of the K 2 in uniform recharge or restricted release position, and can be expected to produce the same undesirable effects in freight service as the P 1 valve does.

Triple valves should be applied to cars in accordance with the catalogue specifications, regardless as to the type of valve that is removed from the car; or, in other words, the triple valve applied to the car must be in accord with the car equipment, regardless of the class of service the car happens to be in.

If any car having a freight equipment is used in passenger service, it must be equipped with the proper sized freight triple valve, which will insure a uniform charge and recharge so far as the triple valve is concerned, and in applying, it will reduce the pressure in the standard freight auxiliary reservoir as fast as the passenger triple valves can reduce their auxiliary reservoir pressure.

While it is never permissible to mix triple valves on freight or passenger equipments where car brakes are concerned, there is nevertheless an exception when a locomotive in passenger service is not equipped with the E. T. brake, and when the tender has an 8-in. equipment.



NEW YORK TYPE L BRAKE VALVE.

In this case the passenger engine tender is equipped with the standard H 1 or F 36 triple valve, which will prevent any overcharge of the tender brake reservoir when other brakes are not being overcharged. Passenger engine tenders requiring larger than 8-in. equipments are fitted with the proper sized passenger triple valve, and when the E. T. equipment is not being used it is generally considered good practice to use the quick action triple valve on the freight tender.

The proper sizes of triple valves for 8-in. freight equipment are Westinghouse H 1 or K 1 and New York F 1 or K 5. For 10-in. brakes the Westinghouse valves are the H 2 and K 2 and the New York H 1 or K 6.

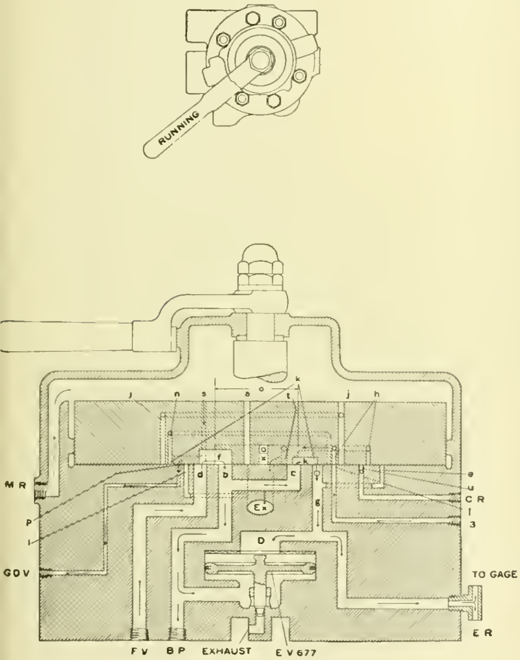
If the valve handle is in running or holding position, main reservoir pressure cannot pass the rotary valve, and instead feed valve pipe pressure enters the brake pipe parts.

In lap position all ports are closed and main reservoir, brake pipe and equalizing reservoir pressures are separated and remain so in service position; thus, when an opening to the atmosphere from the equalizing reservoir is made in service position brake pipe pressure will lift the equalizing piston and cause a discharge of brake pipe air.

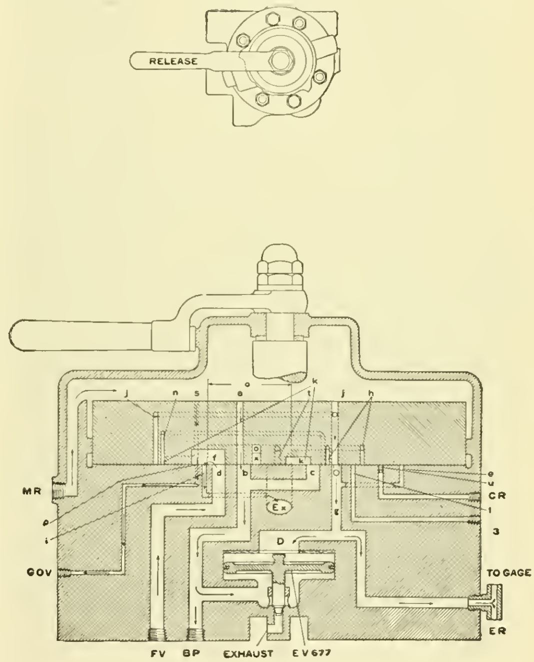
Normally the pressures are always balanced about the equalizing piston, and if the pressure above it is weakened or the pressure below it increased, the

The chamber above the diaphragm is connected to the pipe between the brake pipe feed valve, and is controlled at the adjustment of the feed valve. This pressure, plus the tension of the spring, is what governs the main reservoir pressure in full release, running and holding positions of the automatic brake valve. As the pressure to the under side of the diaphragm of the excess pressure head is cut off by the rotary valve in lap, service and emergency positions, main reservoir pressure will be controlled by the maximum pressure head, which is connected direct to the main reservoir.

The exhaust port of the triple valve of the automatic control valve is piped



RUNNING POSITION.



RELEASE POSITION.

The Type L Brake Valve.

NEW YORK AIR BRAKE COMPANY.

In this issue are views of the New York Air Brake Company's type L brake valve. In release position main reservoir pressure flows through the rotary valve into the brake pipe and equalizing reservoir until all brake pipe parts are charged equal to main reservoir pressure, which is at this time controlled by the excess pressure head of the pump governor, the feed valve pipe pressure remaining at the figure of the duplex pressure controllers adjustment.

piston will be lifted to discharge brake pipe air.

In emergency position a direct opening is made from the brake pipe to the atmosphere which will exhaust all brake pipe and equalizing reservoir pressure.

In the first three positions of the brake valve, main reservoir pressure flows through the rotary valve to the under side of the diaphragm of the excess pressure governor top, and in the last three positions, this flow from the main reservoir to the under side of the diaphragm is cut off.

to the automatic brake valve, and is open to the atmosphere only in running position of the brake valve, this being the only difference between running and holding positions.

In emergency position there is a flow of air from the automatic brake valve through the control reservoir pipe to the control valve which maintains engine brake cylinder pressure at a somewhat higher figure than when in service position.

The air gauges register the usual main reservoir and equalizing reservoir pressure, the smaller gauge registers

brake pipe and brake cylinder pressure. Brake pipe pressure is registered regardless of the position of the brake valve cut-out cock. This is found to be of advantage when the engine is the second one in double heading.

It will be noted that in running position brake pipe pressure is reduced before it enters the brake valve and brake pipe and spring pressure combined on the diaphragms of the excess pressure head of the governor render its adjustment automatic up to the interference of the maximum head.

To cut out the brake valve, close the brake valve cut-out cock, the handle remains in running position.

To arrange for handling the engine engine so that this brake as well as the one in the leading engine can be alternated with the train brakes to keep from overheating tires.

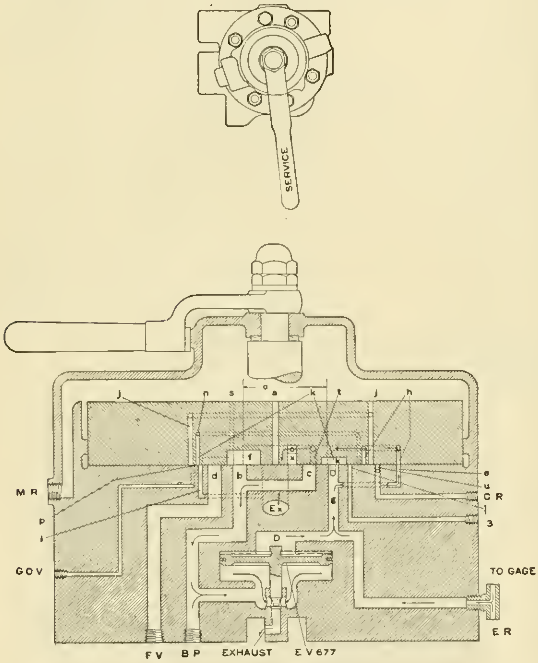
The operation of the engine brake will be explained in the next issue in connection with the automatic control valve.

Main Reservoir Pressure.

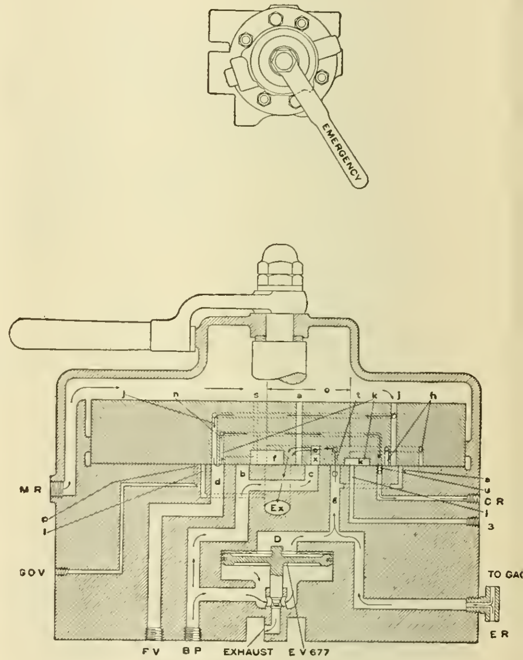
Some years ago the size and types of locomotives built were such that considerable difficulty was at times experienced in locating main reservoirs of the recommended size for freight service, but on the modern locomotive there is ample space in which to locate main reservoirs that will store a sufficient the auxiliary reservoirs on a train of cars requires a certain number of cubic feet of free air, and the higher the main reservoir pressure the greater the number of cubic feet of free air it contains.

If we have a main reservoir of 70,000 cu. ins. charged to 100 lbs. pressure, it contains about 320 cu. ft. of free air, and if the reservoir volume is 50,000 cu. ins. and the pressure 130 lbs., it will contain but about 285 cu. ft. of free air, but if the pressure in the 70,000 cu. in. reservoir is raised to 130 lbs., it will contain 395 cu. ft. of free air.

A little reflection on this point will make it appear that with ample main reservoir capacity, a comparatively low



SERVICE POSITION.



EMERGENCY POSITION.

when boiler is empty, close the brake valve cut-out cock, open the cut-out cock in the dead engine fixture and slack off the adjusting nut of the safety valve about two turns. The automatic valve, as before, remains in running position and the straight air valve in release position.

If no one is to accompany the engine, the automatic brake valve, or, better still, both valve handles should be removed to prevent anyone from moving the handles from their proper positions, which would cause the brake to fail to release.

On descending heavy grades in this manner some one must ride the dead volume of compressed air for present requirements.

While it may be practically impossible to supply an air brake man with more main reservoir volume than he can successfully handle, there are many air brake men who are inclined to believe that the matter of providing sufficient main reservoir capacity is sometimes overdone. The manufacturers assume that the main reservoir capacity for freight service will be approximately 60,000 cu. ins. and therefore recommend a maximum pressure of about 120 lbs., and furnish a pump governor set at this figure.

To release the brakes and recharge air pressure gives satisfactory results, but with a small volume high pressure is necessary to insure a release of the train brakes. Some locomotives have over 90,000 cu. ins. of main reservoir capacity, and it is almost needless to say that such main reservoir volumes necessitate large air pump capacity, because if main reservoir pressure falls below the adjustment of the brake pipe feed valve, the pump must compress air fast enough to charge the large main reservoir along with the brake pipe and auxiliary reservoirs before the equipment is ready for another application.

Thus it will be observed that on de-

scending a heavy grade with a main reservoir volume of 80,000 or 90,000 cu. ins. a large air pump capacity is absolutely essential to the safety of trains if they are controlled with the air brake, and if proper air pump capacity is provided, the exceptionally large main reservoir is unnecessary.

Charging a present day freight train in a specified length of time calls for pump capacity rather than main reservoir volume, and with the necessary pump capacity, a reservoir of 60,000 cu. ins. is considered ample to meet any requirements in freight service. In this connection it is safe to say that the main reservoir pressure or the adjustment of the pump governor should be based upon the capacity of the main reservoir and the air pumps.

With large main reservoirs as large or larger than the recommended size and a pump capacity of 100 or 125 cu. ft. of free air per minute, a maximum main reservoir pressure of 105 or 110 lbs. will be all that is required, but if the pump capacity is from 50 to 70 cu. ft. per minute and the main reservoirs are from 40,000 to 50,000 cu. ins. capacity, 120 lbs. to 140 lbs. main reservoir pressure can be successfully used.

We do not attempt to convey the impression that a man with a good general knowledge of the air brake cannot use large main reservoir volumes and high air pressure to advantage, but as a general proposition combinations of low-pressure with large reservoirs and high pressure with smaller ones will give the best results in average conditions of service.

That the high pressure and large volume can be misused is proven by demonstrations showing that the brake pipe at the head end of a long train can be overcharged to such an extent, and so far in advance of the rear brakes that quick action will occur if the overcharge is followed by an application of the brake, that is, the continued flow of brake pipe air toward the rear end of the train combined with the amount exhausted by the brake valve, lowers the pressure on the overcharged cars rapidly enough to cause the undesired quick action. While this will not likely occur to the engineer who keeps in touch with developments in the air brake art, the weaker brother who has not had the same opportunities and experiences must also be assisted.

The unnecessarily large main reservoir also appears in passenger service, and the disadvantage of too large a main reservoir volume in this class of service is just as apparent as when used in freight service. It takes more than a main reservoir full of compressed air to charge a train of L. N. or P. C. equipments, therefore air pump capacity is the chief consideration, and when this has been secured main reservoir volume is of secondary importance.

There is not much danger of overcharging the L. N. or P. C. equipments with one second's time in release position of the brake valve after an application of the brake, but three seconds' time in release position with the excessive main reservoir volume will sometimes overcharge the P. M. equipment, with the usual result of "sticking" and "creeping on" of brakes.

When summed up, the unusually large main reservoir is of no particular advantage, nor of any particular disadvantage, if the pressures carried conform to its size, and if the engineer using it understands the use and abuse of release position of the automatic brake valve, but if the engineer happens to be somewhat deficient in his knowledge or has any misconceptions of the use of several positions of the brake valve, he will undoubtedly have more success in handling trains when the main reservoir volume very nearly approaches a size generally accepted as a standard.

Influence of Cold on Iron and Steel.

Broken rails and broken axles have caused many accidents during last month with its unusually low temperature, yet certain scientists who are reported to be high authorities concerning strength of material insist that cold does not cause metal to become brittle, and that the idea that such is the case is a popular fallacy. Among the scientists holding these views are Styffe, Fairbairn, Kirkalry, Webster, the United States Government Commission and others; but they have against them all the practical men who have to handle tools or material in zero weather. It is no superstition that induces a wood chopper to warm his ax before beginning work on a frosty morning; and it is the teaching of experience that induces the trackman to lighten the blows on his cold chisel when the temperature is low, and he knows it is not necessary to cut so deeply into the rail to be broken as it would be if the day was warm.

Civil engineers as a rule have insisted that temperature makes no difference to the resisting power of metals, notwithstanding that the popular voice has always maintained that metals break more readily in cold than in warm weather. When rails, axles and tires got breaking during frosty weather, on roads that seldom experienced a single breakage in summer, the popular voice said they were full of frost and that made them brittle. The civil engineers said the ground is rigid and the shocks more severe, thereby leading to breakage. That belief on the part of the civil engineer was based on tests made by scientists which did not demonstrate any difference in the breaking point of metals when cold from what it was at ordinary temperatures. These tests were incorrect and wholly misleading.

The correctness of the popular belief concerning metal getting brittle when cold was vindicated by tests made by a member of the British Institution of Civil Engineers years ago. A series of drop tests were made on axles kept artificially in a temperature of zero and on other axles of the same kind kept at 100 Fahr. The results were that the axles tested warm exhibited an average of 58 per cent. more resisting power than those tested at the lower temperature.

Some twenty years ago Mr. Jos. Ramsey, president of the Ann Arbor Railroad, himself a civil engineer, made a series of experiments on the strength of structural iron and steel under wide ranges of temperature that convinced him the popular belief about the affect of cold was correct. He found that the resistance to impact was materially reduced by the temperature being reduced 100 degrees; and that very low temperature changed the texture of the metal from fibrous to crystalline. Respecting this phenomenon Mr. Ramsey says: "It seems to me that such an effect by low temperature upon iron and other metals is not antagonistic to the natural laws governing such metals as are solid at one temperature and become liquid at a higher one. Heat changes iron from a hard dense mass to one that can be easily drawn out and worked into any shape with a light hammer; increase the heat and the mass is in a pasty condition when it can be rolled and worked like a piece of dough; still farther increase the heat and it becomes liquid and will flow like water. Now take the reverse process. As the fluid iron changes into a solid fibrous material by reducing the temperature, why should not a farther reduction of temperature change the fibrous to the crystalline structure?"

Pamphlet on Scientific Management.

The highly important paper which Mr. W. E. Symons read on "The Practical Application of Scientific Management to Railway Operation," together with discussion of the same, will be published by the Franklin Institute, Philadelphia; price, 75 cents.

The gentlemen who took part in the discussion were F. H. Clark, S. M. Vanclain, George J. Burns, A. L. Conrad, W. J. Cunningham, James S. Eaton, Harrington Emerson, Frank B. Gilbraith, Charles B. Going, G. R. Henderson, B. B. Milner, Angus Sinclair and Walter V. Turner. The discussion of this paper gives comprehensive views on scientific management well worth reading.

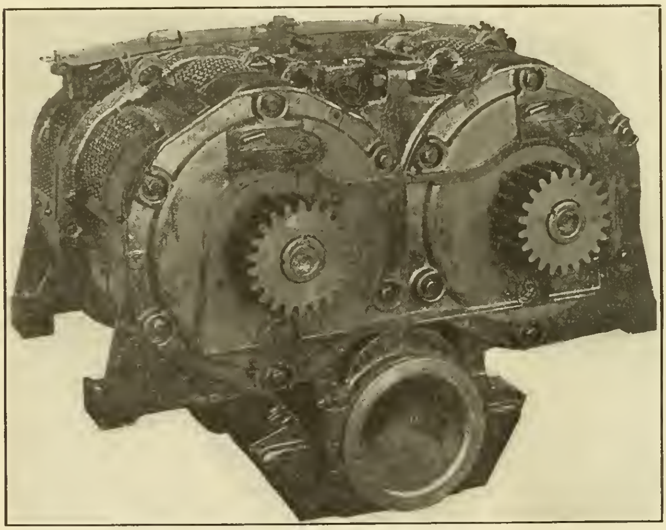
People ordering this valuable pamphlet should address The Actuary, Franklin Institute, Philadelphia.

Electrical Department

New Type of Electric Locomotive.

The New York, New Haven & Hartford Railroad Company has recently ordered from the Westinghouse Electric & Manufacturing Company fifteen articulated truck locomotives, each equipped with eight motors, i. e., two motors per driving axle.

Around each axle is a hollow quill which connects to the drivers by six helical springs and passes through the bearing, shown in the illustration. There is mounted on this quill one large gear, and each of the two motors is geared to it. This equipment, which at first appears more complicated, is in reality lighter and cheaper than a locomotive of the same capacity having one motor per driving axle of the same horsepower as the two motors. This arrangement permits the use of small motors, which are easily handled, for locomotives of large capacity, and the matter of repairs is greatly simplified. Each of the small motors has practically one-half the number of brushes, brushholders, armature and field coils, etc., as has one large motor, so that there is the sume total number of these parts in either case. Both motor pinions drive the same gear, which permits the use of only one gear on the quill, while with the large motor two gears are required and a pinion on either end of the armature shaft. The railroad company has had one of this type of locomotives in operation for several months. It is believed that this type marks a decided advance in the art of building electric locomotives.



NEW TYPE OF ELECTRIC MOTOR.

One Year of Electrical Operation.

November 27, 1911, completed one year's service into the Pennsylvania station, New York City. The official figures show that there were 176,180 revenue trains, and that 99.59 per cent. were on time over this terminal division.

The operation of the electric locomotives, which are the most powerful in existence, has been most remarkable. The total delay and detention for the year was 98 minutes, and only 13 minutes of this is chargeable to the electrical apparatus. The use of field control for speed regulation on these locomotives enables them to run when necessary at very high speeds, and at the same time to start very heavy trains. Each locomotive weighs, complete, 157 tons, and exerts a maximum drawbar pull of 79,200 lbs.

Results of Electrifying the Hoosac Tunnel.

Continuous operation by electric power in the Hoosac Tunnel of the Boston & Maine Railroad, was started by the Boston & Maine Railroad May 27, 1911. Since starting, the electric service has never been interrupted. The locomotives, generating station equipment and the line material were furnished by the Westinghouse Electric & Mfg. Company.

The Hoosac Tunnel is the longest tunnel in the United States. It pierces the range of hills between the Hoosac and the Deerfield rivers in the Berkshire Hills, and is 25,081 ft. long. To drain off the large amount of water the tunnel was run on a grade of 26.4 ft. to the mile from each portal to a short level stretch in the center. At the center there is a shaft 1,028 feet deep, extending to the surface for ventilation.

The electric zone extends from the little tunnel west of North Adams station to a point about a quarter of a mile east of Hoosac Tunnel station, a total distance of 7.92 miles. The electrification includes the yards at North Adams, about two miles of main line between North Adams and the west portal, four and three-quarter miles of tunnel, the yards on the east side and about three-quarters of a mile of main line. There is in all 21.31 miles of a single track electrified.

The Westinghouse 11,000 volt single-phase system and Westinghouse single catenary overhead construction were chosen as best adapted for this electrification, and the equipment is in many respects similar to that on the New York, New Haven & Hartford Railroad between Woodlawn, N. Y., and Stamford, Conn.,

Three of the five Westinghouse locomotives are intended primarily for freight service, and have a maximum tractive effort of 67,000 lbs., and a maximum speed of 30 miles an hour. The other two locomotives are intended for combination passenger and light freight service and have a maximum tractive effort of 40,000 lbs and a maximum speed of 50 miles an hour. These locomotives are identical with the exception of the gear ratio, and by changing the gears and pinions it would be possible to change a passenger locomotive over to a freight or a freight over to a passenger. Each locomotive weighs 130 tons and is 48 ft. long between couplers. At present these locomotives are drawing 60 to 70 trains a day through the tunnel. Freight trains of 1,600 tons trailing load and their steam locomotives are hauled through in 15 to 20 minutes, and passenger trains of 400 to 500 tons with their steam locomotives are hauled through in 7 to 8 minutes; a wonderfully good performance.

Construction of a Modern Railway Motor.

In our previous article we have described two types of frames, namely, the box and split types, outlining the advantages and disadvantages of each; the housings, explaining the method of lubrication; the construction of the field coils and poles, and how they are assembled in the motor frame. We will now describe the armature, which is the rotating part of the motor, and will consider those built by the Westinghouse Electric & Manufacturing Company.

THE ARMATURE.

The armature is composed of the spider, the core, the commutator, the winding and the shaft. The spider, shown by Fig. 6, is made up of three parts, the main casting (M), the front end bell or core casting (F), and the ring nut (R). The casting (M) is bored out to very accurate dimensions so that the armature shaft will press in under 30 to 40 tons pressure. The outside dimension is also carefully finished, as the core is built upon this diameter, and a very close fit is desired. Deep grooves (G) are provided in the cast-

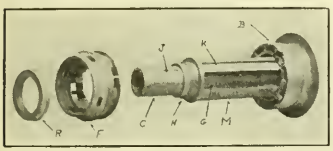


FIG. 6.—THE SPIDER.

ing (M), which pass through the rear end bell (B), and serve as ventilation ducts for the armature, as will be explained later.

After boring and turning to proper diameter, the casting (M) has the keyways (K) and (J) cut, to prevent turning of the core and commutator, respectively. The core is now ready to be built. It consists of iron punchings, a few mils thick, assembled on the casting (M), as shown in Fig. 7. The keyway and key serves also to line up these punchings or laminations so that the slots (T) will be properly formed. After the proper amount of laminations are put in the spider, they are put under a pressure of about forty tons, the front end bell (F) put into place, and the ring nut (R) screwed on the threads (H), which holds all in place and under pressure.

While the core is being built up there are placed at certain positions a lamination with raised ribs, so as to leave openings in the core, and so that it will not be of one solid mass. The position of these special laminations are shown at D, Fig. 7. These openings or ducts communicate with the grooves G, Fig. 6. The rotation of the armature sets up a natural ventilation. Air is drawn in through these grooves (G) and is blown out through the ducts (D) in the core. We all know that electricity flowing through a wire generates heat, so that when the motor is working heat is conducted away from the coils to the core, and the air passing through the ducts cools the core

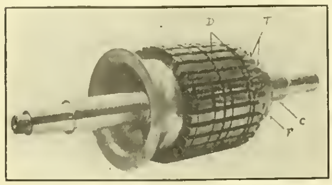


FIG. 7.—ARMATURE CORE.

so that the heat is dissipated. The next step in the construction of the armature is to press the commutator on to the spider at diameter C, Figs. 6 and 7.

THE COMMUTATOR.

The commutator is one of the most important parts of an electric motor. It serves as a means of connection between the winding or coils on the armature core and the source of power, and all of the current taken by the motor flows in and out of the commutator through the brushes. The commutator also rotates with the spider and therefore the material of which it is composed must be a good heat conducting metal and of high elastic limit. The best material is hard drawn copper, and this is invariably used.

Figs. 8 and 9 show a view of the

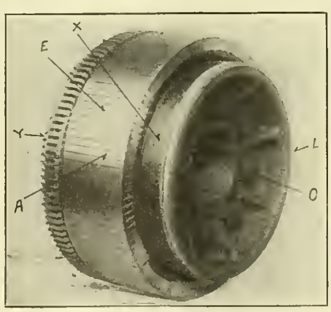


FIG. 8.—COMMUTATOR.

commutator assembled ready to press on the spider and half of a diametrical cross section. The commutator is made up of a certain number of bars (A), according to the number of slots (T) in the core (Fig. 7), and the number of coils placed in these slots. Each bar (A) is practically the same shape, as shown in the cross sections and about ¼ in. thick, and each is insulated from the one on either side by a mica segment, a few mils thick, of the same general shape as the bar. The correct number of bars are assembled, and are then held together by a large iron ring which can be decreased in size, thus forcing the bars together under pressure. It is then necessary to place the whole in a hot oven so as to allow the mica to soften and form to the irregularities of the copper, and thus prevent movement of bars after commutator is finished. After removing from the hot oven two V-shaped slots (W), are cut one on either end at definite angles, to provide a means of clamping and holding the bars (B) in place after the iron ring is removed.

The method of clamping these bars is as follows: Two V rings (L and N) are inserted in the V-shaped slots (W), previously cut in the bars, and are held together by the bolts (O). To prevent the rings short-circuiting the commutator bars (B), moulded mica V rings (P and Q) are placed in the slots before the bolts are tightened, and a mica bushing (S) is slipped into position also. After the bolts are firmly set up the iron ring can be removed. The commutator is now ready with the

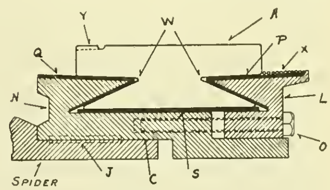


FIG. 9.—CROSS SECTION OF COMMUTATOR.

exception of two things to press on the spider at diameter C (see Figs. 6 and 7). It is necessary to protect the mica V ring (P) where it projects beyond the commutator bar and a string or tape banding (X) is used pointed with shellac or other equally good insulating varnish. Slots (Y) must also be cut in each commutator bar, into which the wires from the coils are soldered.

Railway Operations in Uruguay.

The proceedings at the annual meeting of the Central Uruguay Railway Co. of Montevideo (Ltd.), and Northern and Eastern Extension Railways show a large increase in the gross earning of the combined system over previous years, the total amount for the year ending June 30, 1911, being $4,951,192. The report shows also a considerable increase in the tonnage handled as compared with previous years, the total being 964,026 tons; and also in the carriage of live stock. The report indicates progress, both in Montevideo and in the interior of the republic.

Mikado Type of Locomotives for the Erie Railroad

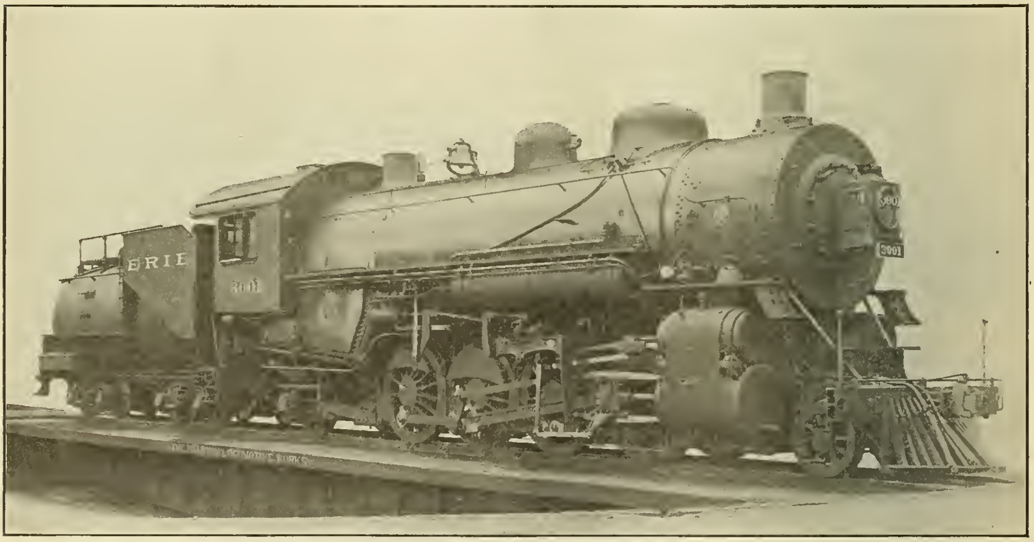
The Erie Railroad has recently received from the Baldwin Locomotive Works twenty Mikado type locomotives for service on the Cincinnati division. These lomotives are being introduced in order to increase the capacity of the division and relieve freight congestion. The average load per pair of driving wheels is very nearly 60,000 lbs., and in point of total weight the locomotives are the heaviest of their type thus far completed by the builders. They are built in accordance with specifications furnished by the Railroad Company and are designated as class N-1.

Compared with the class H-21 Consolidation type locomotives used on this road, the new Mikado type locomotives show an increase in tractive force of 35 engines plus the added advantage of taking the larger tonnage at a higher speed than could be maintained by the class H-21 locomotives.

The boilers of the Mikado type locomotives present a few features that are worthy of mention. The firebox is radially stayed, and the front end of the crown is supported by four transverse rows of flexible bolts, which are used instead of the customary arrangement of T-Irons and expansion links. The depth of the throat, measured from the under side of the barrel to the bottom of the mud ring, is 25 in. This provides ample room for the brick arch, which is supported on four 3-inch water tubes. The superheater is of the Schmidt type. It provides 1,050 sq. ft. of through lugs cast in the solid frames.

The steam pipes in these locomotives pass out through the sides of the smoke box, and deliver steam directly to the steam chests. The steam distribution is controlled by 16-in. piston valves which are driven by Baker gear. The valves are set with a maximum travel of 6 in. and constant lead of ¼ in. The steam lap is 1 in., and the exhaust clearance 1-16 in. The valve motions are controlled by the Ragonnet power gear.

The tender is of the Vanderbilt type, with capacity for 9,000 gallons of water and 16 tons of coal. The tank has a diameter of 8 ft. 9 in., and the frame is composed of 6 x 4 in. angles, with steel bumpers. The trucks have cast steel side frames and steel tired wheels.



2-8-2 TYPE OF LOCOMOTIVES FOR THE ERIE RAILROAD.
Wm. Schlafge, General Mechanical Superintendent. Baldwin Locomotive Works, Builders.

per cent., in weight on driving wheels of 31 per cent., and in total equivalent heating surface of 83 per cent. The H-21 locomotives use saturated steam while the N-1 engines are equipped with firetube superheaters. In making the above comparison each square foot of superheating surface is considered equivalent to 1½ square feet of water evaporating surface. On the basis of water evaporating surface alone, the N-1 locomotives show an increase of 33 per cent. over the class H-21, and this is practically in proportion to the increase in tractive force. Therefore, the increase in relative boiler capacity, measured on a heating surface basis, is provided by the superheater, and is approximately 50 per cent. This means increased hauling capacity for the new superheating surface, and the elements are located in 36 tubes each 5½ in. in diameter. The dome base and body are flanged from a single piece of steel plate. The longitudinal seams are all placed on the top center line. They are welded at the ends, and have diamond shaped welt strips inside.

The frames are of vanadium cast steel, with back sections of hammered iron. The front frames are single and are cast in one piece with the main frames, which are six inches wide, and measure seven inches in depth over the pedestals. The rear frames are in the form of slabs and are 2½ in. wide. The equalization system divides between the second and third pairs of driving wheels. The spring links are here held by pins which pass

These locomotvies have a ratio of adhesion of 4.12. The weight on drivers is thus fully utilized, and as has been pointed out, the boiler capacity is sufficient to insure free steaming. The locomotives have been specially designed to meet difficult operating conditions, and preliminary trials indicate that their performance will be most satisfactory.

The following are some of the general dimensions of this type of locomotive:

Gauge, 4 ft. 8½ in.; cylinders, 28 in. by 32 in., valves, balanced piston.

Boiler—Type, straight; material, steel; diameter, 84 in.; thickness of sheets, 15-16 in.; working pressure, 170 lbs.; fuel, coal; staying, radial.

Fire Box—Material, steel; length, 120 in.; width, 84 in.; depth, front, 88½ in.;

depth, back, 72¾ in.; thickness of sheets, sides, ⅜ in.; thickness of sheets, back, ⅜ in.; thickness of sheets, crown, ⅜ in.; thickness of sheets, tube, ⅝ in.

Water Space—Front, 6 in.; sides, 6 in.; back, 6 in.

Tubes—Diameter, 5½ in. and 2¼ in.; material, 5½ in., steel; material, 2¼ in., iron; thickness, 5½ in., No. 9 W. G.; thickness, 2¼ in., 0.125 in.; number, 5½ in., 36; 2¼ in., 232; length, 21 ft. 0 in.

Heating Surface—Fire box, 188 sq. ft.; tubes, 3,936 sq, ft.; firebrick tubes, 31 sq. ft.; total, 4,155 sq. ft.; grate area, 70 sq. ft.

Driving Wheels—Diameter, outside, 63 in.; diameter, center, 56 in.; journals, 11 in. by 14 in.

Engine Truck Wheels—Diameter, front, 33½ in.; journals, 6 in. by 12 in.; diameter, back, 42 in.; journals, 8 in. by 14 in.

Wheel Base—Driving, 16 ft. 6 in.; rigid, 16 ft. 6 in.; total engine, 35 ft. 0 in.; total engine and tender, 66 ft. 10½ in.

Weight—On driving wheels, 236,950 lbs.; on truck, front, 30,200 lbs.; on truck, back, 54,900 lbs.; total engine, 322,050 lbs.; total engine and tender, about 485,000 lbs.

Tender—Wheels, number, 8; wheels, diameter, 33 in.; journals, 6 in. by 11 in.; tank capacity, 9,000 gals.; fuel capacity, 16 tons; service, freight.

Engine equipped with Schmidt superheater. Superheating surface, 1,050 sq. ft.

Railroad Notes

The Vulcan Iron Works, Wilkes-Barre, Pa., are building a 10-wheel locomotive, and a special Forney locomotive for Manuel C. Fernandez, Cardenas, Cuba. Special locomotives are also being furnished by the same company for the Porto Rico Irrigation service, and the Warrior Black Creek Coal Co., of Alabama.

The Rock Island is building a cut-off of 67 miles between Carlisle and Allerton, Ia., known as the St. Paul & Kansas City Short Line. It proposes to have this route completed by next September. This cut-off gives the Rock Island a direct line of only 489 miles between St. Paul and Kansas City, 43 miles shorter than any other.

An equipment trust agreement, by which the St. Louis and San Francisco Railway Company purchased rolling stock valued at $1,776,000 was filed in the Texas Secretary of State's office at Austin. It calls for 12 locomotives, 12 mail cars, 500 steel underframe refrigerating cars, 2 baggage cars, 2 mail and passenger cars, 15 mail coaches, 10 chair cars, five dining cars, three buffet dining cars, four buffet coaches and a coach dining car.

D. B. Hanna, vice-president of the Canadian Northern, states that the line from Montreal to the Pacific Coast will be completed by January 1, 1914.

Construction work is progressing rapidly on the surveyed sections between Montreal and Port Arthur, and between a point on the western boundary of Alberta to the Pacific Coast. Final plans regarding the construction of terminals at Montreal will be announced.

Secretary of the Interior Fisher, in his annual report made public today, calls attention to affairs in Alaska, and recommends steps which, he says, should be taken at once to remedy conditions there. Secretary Fisher visited Alaska last summer and his comments and recommendations have been awaited with interest. The secretary's most striking recommendation is that the government itself go into business of railroad building in Alaska.

A new railway will be commenced in the spring, running 200 miles from this city up the St. John River to Grand Falls. It is understood that it will constitute the main line of the Grand Trunk Pacific and Canadian Northern Railway to this city, branching off at Grand Falls from the Grand Trunk now built to Moncton, N. B.

The line will be built by private capital, backed by the Dominion and provincial governments, and will probably be the most important in the province, traversing the St. John River Valley for the whole distance. It will open up vast timber areas and rich farms and fruit lands now depending entirely on river transportation.

An important movement is looked for by railroad men as a sequel to the Pennsylvania creating the Central system of the lines west and the establishment of headquarters in Toledo. They anticipate that it means a line from Toledo to Chicago and to St. Louis, and possibly the building of a line between Toledo and Detroit.

At present there is a gap to be closed between the Pennsylvania's terminal in Toledo and the Logansport division at Butler, Ind., 60 miles. From Butler, it is assumed, the route from Toledo to Chicago would be over the Logansport branch to Columbia City, Ind., and from there to Chicago over the main line between that city and Pittsburgh, known as the Ft. Wayne route.

The Pennsylvania railroad, having experienced much inconvenience in forwarding and receiving train orders and instructions by telegraph and telephone during stormy weather, due to broken wires, has installed wireless stations at Altoona and Harrisburg, Pa., a distance of 132 miles. The company is now conducting tests of dispatching by means of the wireless telegraph.

While no report has been made public as to the success of the experiment, it is said that messages were received and dispatched in all sorts of weather. There is some talk of installing a station at the Broad street terminal in Philadelphia, Pa. If the service proves satisfactory the whole system, including Pittsburgh and the lines west, will be equipped.

The New York Central Lines have increased their order for locomotives given to the Baldwin Locomotive Works, and it is expected that 70 additional locomotives will be ordered shortly, making a total of 150 for the New York Central system. Orders have been placed with the American Locomotive Company as follows: Boston Revere Beach and Lynn Railroad, two Forney type passenger locomotives; Chicago and Illinois Midland Railway, one saddle tank switching engine; Chicago and Northwestern Railway, one Mogul passenger locomotive, and 51 passenger and freight engines and one rotary snow ploy by the Canadian Northern. Two ten-wheel locomotives for the New Orleans and Great Northern, and also for the Grand Trunk 10 consolidation engines, while its subsidiary company, the Montreal Locomotive Works, also received an order from the Grand Trunk, for ten switchers.

Expenditures involving millions of dollars, including the proposed completion of double-track construction between Chicago and New York, have been announced by the management of the Erie road. Plans are now being worked out for the beginning of work next spring on a double-track route between Chicago and Marion, Ohio, which will be the final link in its double-track line. A large number of laborers are being engaged and contracts have been let for material and supplies. The distance between Chicago and Marion is 26 miles, and it is expected that the undertaking will be finished within a few years. During the past year 42 miles of double track were constructed between Leavittsburg and Marion, and arrangements have been completed for building an additional 11 miles before the end of next month. During the past few years the company has replaced 384 bridges with steel structures capable of carrying the heaviest equipment, and at the present time there is not a single wooden bridge on the company's main line between New York and Chicago. During the same period 177,000 tons of new steel rails have been laid.

Shop Management.

The publishers of the *Journal* of the Franklin Institute are publishing the discussion that followed the reading by Wilson E. Symons of a paper on "Scientific Management in Railway Operation." Mr. S. M. Vanclain, vice-president Baldwin Locomotive Works, said: "It has been some time since I was engaged in active railroad work, but I am still engaged in building locomotives for those who are proficient in railroad management, wherewith to carry on their business.

"The term 'Scientific Management' is, to my mind, just what Mr. Symons has described it—somewhat of a misnomer. It might be called 'economical' management with greater accuracy, because economical management has been in existence ever since I was a boy, and probably before that. We have read a great deal in the newspapers lately as to how managers should manage their property to derive economy, telling us just how to do it, and how many millions of dollars could be saved by doing it just that way. Now, I do not know of any persons more anxious to save those millions than are the railroad managers themselves.

"The first economical railroad management I was interested in was in 1875. The master mechanic of one of our large railroad systems happened to have been an inspector of locomotives at the Baldwin Locomotive Works, and when he returned home immediately set the wheels in motion and turned his attention to study efficiency and economy in the repair of our locomotives, and the same institution established at that time has been continued and perfected, and I doubt if today any other railroad in the United States has a more perfect system of handling its locomotives than has this same railroad. If this is true—and being familiar with it from the time it was started I know it to be true—it proves that there has been, and still is, some economic management by railroad officials.

"When Mr. Symons calls attention to the scientific management now in force on the Santa Fe Railroad, and of which much has been said pro and con —it having been the only road so far that has striven by such methods to reduce their costs—we must consider that many of their shops are located where it is difficult to obtain men, and that the cost of doing their work is not only influenced by material and prices, but by the enormous size to which their locomotives has increased. The size of the locomotives on the Santa Fe road in 1910 was between 50 and 75 per cent. greater than it was in 1900, if locomotives are to be measured by their tractive power. Therefore, what is true of that road will also be true of other roads, and it would take a long time to analyze the figures and make a thorough study of them as presented in these tables. Mr. Symons has no doubt made a thorough study of them, and so is not to be thought guilty of eliminating facts before this meeting, for he certainly will have to stand for them hereafter. But I call your attention to the fact that locomotives have increased greatly in size during the last decade, and the possibility is that they will increase still more, and the probability is that railroad management will continue to be called down because their expenses are increasing per engine mile. Also each locomotive is being worked up to a greater efficiency, or, rather, to a greater percentage of its maximum efficiency, by the railroads. All the devices of their mechanical engineers, all the devices they can secure, are being tried in order to promote the efficiency of the locomotive, and, in addition, on many railroads, large expenses are being incurred in modifying and altering the type of locomotives, all of which, or much of which, may be charged to their maintenance cost.

"Another item is the question of speed. The feeling is that we must go faster. Ten years ago none of us would have thought of flying, but the idea of our getting up in the morning now without giving a thought to a flying machine is ridiculous; everybody does so, and we believe that these things are going to be instruments of common use. The flying machine today is one of the most discussed things of modern times; anything with an element of danger in it is sure to draw a crowd. We must now run our freight through from the West to Philadelphia or to the seaboard in a specified number of hours; otherwise our freight is passed over to another road that will maintain its power to such a point as will enable it to give satisfactory service under guaranteed conditions.

"Having been an employer of labor all my life, I naturally feel that every employer shoud start out to save money; most employers save it from the wages paid their men. Materials bought in the market are standard, and if we economize we must do so in our labor by the scientific handling of that labor. If all laboring men were precisely the same, a system could probably be established by which we might handle all our workmen like so many machines; but they are not all precisely the same. Go into a stocking factory and you will find, say, twenty-five machines operated by one woman, all attending to business and producing with a maximum efficiency. In a machine shop, however, your human machines are not all of maximum efficiency; they are of variable efficiency, and you cannot change it. You cannot weed out and give your competitor all the poor ones, because he very wisely won't have them. You must be content with a proportion of the good and of the bad and of the indifferent. There is nothing so plentiful as poor labor, and that you do not want at all. If you want to save money from labor on a railroad you cannot save it by reducing the president's salary; you cannot save it from the clerks; you cannot save it from the roadmen, as they are mostly protected by unions; you have to save it in the shops. I do not care what business you are in, you must save it from the labor in your workshops. No one ever thinks he is paying too much for his materials, as prices are fixed; therefore you must save it out of your labor. Now, if my memory is correct, there are some 310,000 shopmen in railway shops throughout the country, and if we are going to save a million dollars daily from these 310,000 shopmen, we would have to save about $3.30 a day from each one, which would exceed their average daily wage.

"I did not expect to be called upon to speak this evening, but I happen to have with me a little memorandum that I carry around for my own protection, because when everyone is attacking you for efficiency and efficient management, or inefficient management, it is very interesting to be able to go back twenty or thirty years—depending upon your own age, of course, for your ability to do so—and compare notes. It is more important that a man earn a thousand dollars a year than it is that he gets forty cents an hour for his day's work and only works two-thirds of the days in the year. He must have a living wage, and in order to do that, he must have a rate of pay per hour or must have the privilege of working a sufficient number of hours per day to insure him a living rate of wage per week upon which he can support his family. Suppose we go back to a low efficiency working standard such as we have had for a good many years and compare the pay of our workmen. For instance, in 1873 we had no electricity, no labor-saving devices, etc. In 1885 the Baldwin Locomotive Works had less than 500 h. p. in the entire works; it now takes 20,000 h. p. to run it. In 1873 the wages averaged $13.73 per week; in 1905 they were $13.93, after which there was a general reduction of 10 per cent. in all labor throughout the country; but in 1905 we ran $13.53 a week. In 1906 business was off a little, and the men averaged $13.18 a week, including all holidays taken out, etc. In 1907 it was $13.37 a week, and in 1910 it averaged $13.41 a week. For

the first nine months of last year it averaged $13.71 a week. To accomplish this we have spent during the last few years about four millions of dollars to increase our facilities, not by employing a thousand clerks to hold a stop-watch over every man in the place to see that he did not waste a minute, but in carefully providing these men, whose power is artificial ability, with suitable tools and labor-saving devices for handling their work, and sufficient power to get the full capacity out of their machines, and when we had done this we gave each man a special notice that no man would be discharged for breaking his machine, and there would be no reduction in his pay. Our men during the last five weeks of this system averaged $14.14, the next week $14.12, the next $14.16, the next $14.20, and the next $14.21, or a maximum variation from the minimum to the maximum average weekly rate of pay of only nine cents a week. This is in a shop, gentlemen, that is employing 14,000 men, and whose wages are paid to them every week. The men are working faithfully. We have just gone through a little labor experience; the last trouble we had was in 1859. Most of the men who disagreed with us were led astray by labor agitators. We have eradicated the idea that was being grafted on these men as to how a shop should be managed, but the average rate of pay of the men in the shop now varies but a few cents, and the same men now earn an average of twenty-five cents a week higher, showing that by their present system of employment they are able to produce better results and earn higher wages. This rate of pay may seem low, but this rate of pay is high, because if you will look up statistics you will find the average pay of the American mechanic is only about $600 a year. But the American workman is not employed all the time; his employer unwisely sacks him upon the least provocation in order to save his wages, without ever giving a thought as to how the working man is going to live.

"These averages I have given you, gentlemen, cover men who earn from five cents an hour as first-year apprentices, to men who applied to their occupations the highest principles of economic management and who have earned as high as sixty cents an hour. Being now a manufacturer, it is impossible for me to discuss this paper further from the railroad man's standpoint. I believe in scientific management and in economic management, but I do not believe in an espionage over human beings that grinds them down and makes them feel that they are owned body and soul by the men who control them."

When Minot Was Superintendent of the Erie.

In the early days on the Erie there was little need for superintendents or other officers, because the engineers and conductors were the powers that operated the railroad. Whatever regulations or changes proposed by the nominal officers of the company were taken up and discussed by the trainmen, and if they did not vouchsafe their sanction and support there was no use in trying to put new rules or changes into effect. The engineers and conductors generally agreed that between them all questions relating to train operating should be settled; but they often differed greviously among themselves and their quarrels were at times highly inconvenient to the company.

The road had been in operation about nine years, every successive year finding the trainmen more thoroughly in control, when in 1850 Charles Minot was appointed superintendent. Mr. Minot was a New England lawyer, with strong natural affinities for mechanics. He learned to run a locomotive, and railroad life attracted him so much that he gave up a good law practice to become a railroad man. One of his first acts, on becoming superintendent of the Erie, was to formulate a complete set of rules of train operating. This had not been done before, and the rules arranged by Mr. Minot became the foundation on which nearly all American railroad companies formed their rules of operating. Mr. John C. Stuart, vice-president of the Erie, has a copy of the original Minot rules which he highly cherishes.

These rules were of a highly practical character, and every one of them was made to be obeyed. They made no provision for the engineers and conductors interfering with the management, and on that account gave great dissatisfaction to the trainmen. But Mr. Minot was a strong, aggressive person, and he soon proved that the rules had to be obeyed. There was a wonderful amount of kicking, but nobody was hurt except an occasional stronghead who indulged in active rebellion. He always received permission to air his grievances elsewhere.

One time Mr. Minot arranged a new time table, shortening the time of trains between Clermont, the Eastern terminus, and Dunkirk. The passenger engineers, as usual, got discussing the new time card among themselves and decided that the time was too fast and could not be made. They sent this opinion to Mr. Minot. On the morning that the new time card was to take effect Mr. Minot was at Clermont station. When the engine backed up to couple on to the train Mr. Minot stepped into the cab and told the engineer that his services were not needed for that run. The superintendent ran each engine in succession to Dunkirk, the Western terminus, and went in on time. In each case he left the engineer behind.

After performing this feat Mr. Minot brought all the engineers to hold a consultation and assured them that the freight engineers were perfectly able and willing to make the time of the new time card. All the passenger engineers then decided that they could do anything the freight men could do, and no difficulty was experienced in making the new schedule time.

A Biter Bit.

The man who invented the remark: "I know when I have got enough," was a benefactor to the human race, if they only knew it. But he should get out another: "I know when I have said enough." Railroad men should think of this; for instance, what is the use of superfluous remarks in an accident report? A few years ago, on a prairie road, the writer was riding on a freight train that passed a station where a red flag had been displayed and blown away by the wind.

An extra was to meet the freight at this station, the orders being to hold the freight. A mile from the station we rounded a curve and saw the extra on a straight piece of track two miles away. We stopped, sent out a flagman and backed up. The poor operator was half crazed by the break, and the conductor put in his time abusing him. The extra passed without stopping, and after getting orders we went on. The conductor, in his report, said not a word of the blowing away of the flag, but added to the end of his remarks: "It was a very close call for us all, and this operator should be dismissed." The division superintendent was on that extra, and called on the operator the next day, got a frank explanation, was shown that the old station was arranged with the telegraph office in the rear, and the freight room and waiting room in front of it, and between it and the main track. The operator could not see the flag, and it had blown out of a hole in the post provided for it. The result was, that the superintendent ordered that station remodeled, and all the others like it, and he suspended Mr. Conductor for thirty days "for misrepresentation and attending to duties delegated to officers," and no tears were shed. A plain, truthful statement of facts is what is wanted, without recommendation or comment.

Government.

The correct theory of government is to make it as easy as possible for people to do right—and as hard as possible for them to do wrong.—*Gladstone.*

Items of Personal Interest

Mr. H. F. Martyn has been appointed general foreman of the Rock Island shops at Eldorado, Ark.

Mr. A. Biser, machinist, has been appointed night roundhouse foreman at the Avon shops of the Erie.

Mr. S. J. Elkins has been appointed general foreman of the International & Great Northern at Palestine, Tex.

Mr. William E. McIntyre has been elected first vice-president of the Manning, Maxwell and Moore Co., of New York.

Mr. T. S. Davey, acting master mechanic at Logansport, Ind., on the same road.

At a meeting of the board of directors of Manning, Maxwell & Moore, Inc., held January 26, Mr. James B. Brady was elected vice-president in place of Mr. W. O. Jacquette.

Mr. J. J. Creegan, for some years switchman of the Susquehanna yards of the Erie, has been promoted to the position of foreman of laborers of the Susquehanna shops.

Mr. F. W. Burch has been appointed roundhouse foreman of the Rock Island at Little Rock, Ark., and Mr. J. K. Morgan has been appointed general foreman of the same road at Argenta, Ark.

Mr. R. J. Turnbull, assistant superintendent of machinery of the Missouri Pacific at St. Louis, Mo., has been appointed acting superintendent of machinery, with office at St. Louis, succeeding Mr. J. W. Small.

Mr. J. T. Wallace has been appointed general superintendent of motive power of the Pennsylvania Railroad, with office at Altoona, Pa. Mr. Wallace was formerly in the employ of the West Jersey & Sea Shore Railroad.

Mr. Charles M. Lyle, for several years with Manning, Maxwell & Moore, in charge of their Southwestern territory, with headquarters in St. Louis, has resigned to accept the management of the St. Louis office of the Niles-Bement-Pond Company.

VETERAN ASSOCIA

chanic of the Erie shops at Stroudsburg, Pa., has been appointed master mechanic.

Mr. J. Hughes has been appointed general foreman of the United Fruit Company's locomotive shops at Nipe Bay, Cuba.

Mr. J. J. McNeill has been appointed supervisor of locomotive operation of the Erie Railroad, with office at Cleveland, Ohio.

Mr. E. Hjorth succeeds Mr. W. H. Baker as general foreman of the Chicago & North Western at Belle Plaine, Iowa.

Mr. C. E. Dafoe, general superintendent of the Northern Pacific at Livingston, Mont., has been appointed manager of the Midland, with office at Winnipeg, Man.

Mr. G. B. Travel, master mechanic at Dennison, Ohio, of the Pennsylvania Lines, has been appointed master me-

Mr. C. E. Lester has resigned as general foreman boiler maker of the Erie at Meadville, Pa., and has accepted the position of assistant master mechanic of the Baltimore & Ohio, with office at Pittsburgh, Pa.

Mr. Howard D. Taylor, superintendent of motive power of the Philadelphia & Reading, has resigned, and Mr. F. G. Thomson has been appointed acting superintendent, with headquarters at Reading, Pa.

Mr. Samuel G. Thompson, assistant engineer of motive power of the Philadelphia & Reading, has been appointed acting superintendent of motive power and rolling equipment, with office at Reading, Pa.

Mr. W. N. Spangler, supervisor of signals of the Pennsylvania at New York, has been appointed inspector of signals at Philadelphia, Pa., and Mr. B. F. Oler, supervisor of signals at Camden, N. J., succeeds Mr. Spangler.

Mr. F. K. Murphy, supervisor of air brakes of the Cleveland, Cincinnati & St. Louis, has been appointed master mechanic on the same road, with office at Brightwood, Ind., succeeding Mr. F. M. Lawler, retired on the pension list after forty-one years' service.

Mr. C. W. Cross, superintendent of apprentices of the New York Central & Hudson River at New York, has been transferred to Chicago, and Mr. G. W.

Good, supervisor of piece work, has also been transferred from New York to the New York Central Lines West of Buffalo.

Captain George McCormick, mechanical engineer of the Galveston, Harrisburg & San Antonio, has been promoted to assistant superintendent of the El Paso division of the road, in place of Mr. W. G. Fitzgerald, who has been granted an indefinite leave of absence on account of ill health.

Mr. Thomas Rumney, for five years general mechanical superintendent of the Erie, resigned last month, and has become affiliated with the executive staff of the Chicago, Rock Island & Pacific at Chicago, in place of Mr. W. A. Nettleton, formerly superintendent of motive power. Mr. Rumney will have the title of assistant second vice-president.

the success of a master mechanic in places where work is plentiful and the facilities for doing it by no means perfect.

Mr. L. R. Laizure, who has been transferred from the position of master mechanic of the Erie at Cleveland to the same position at Hornell, has been wonderfully successful in the highest work a master mechanic can do, that of obtaining long mileage from the motive power without engine failures. A framed inscription in Mr. Laizure's office tells that the locomotives under his charge on the Mahoning division had run a whole year without a single flue failure. The secret of his success he attributes to watching the details closely and applying the needed stitch in time.

Mr. John Moore James has been appointed superintendent of motive power

ledo and the Marietta, formerly in the Northwest System.

The following appointments became effective January 1, as a result of the above change in organization:

In the motive power department the following changes were made:

P. F. Smith, Jr., became superintendent of motive power of the Central System. His position as master mechanic at Columbus, Ohio, was filled by the transfer of G. B. Fravel, formerly master mechanic at Dennison, Ohio. J. J. Walsh, formerly master mechanic of the Logansport shops, was transferred to Dennison; F. V. McDonnell, formerly master mechanic at Mahoningtown, Pa., was transferred to Logansport; H. H. Hilberry, formerly master mechanic at Toledo, was transferred to Mahoningtown, Pa.; and J. W. Hopkins, formerly general foreman at

L PLATE RAILROAD.

Mr. H. L. Tinton, who was for several years general foreman of the locomotive shops at Eastern Rigoff, N. M., has been appointed road foreman of engines in charge of all engines in the Eastern division of the Santa Fe, with office at Sedalia, Mo. Mr. Tinton has had a wide experience, having filled the office of foreman and general foreman in the employ of the Missouri Pacific before taking service in the Santa Fe.

Mr. A. J. Boyden, who has been promoted from the position of general foreman at Hornell to be master mechanic at Cleveland in the Erie changes, has made an excellent record as a general foreman, and will no doubt make good in the higher position. Mr. Boyden is a clear-headed, energetic man, with a high capacity for handling men, attributes that ensure

of the Western Pennsylvania division of the Pennsylvania Railroad, with office at Pittsburgh, Pa. He served an apprenticeship as a machinist in the company's shop at Altoona, Pa., and during his twenty years of service has filled many positions in the mechanical department.

In order better to administer both the traffic and transportation affairs of the Pennsylvania Lines west of Pittsburgh, the management has established an additional grand division to be known as the Central System. This change in organization became effective yesterday.

The Central System is composed of the Cleveland, Akron & Columbus Railway, with its two divisions, the Akron and the Zanesville, heretofore operated by its own separate organization; and the Toledo, Columbus & Ohio River Railroad with its two divisions, the To-

Richmond, Ind., was made master mechanic at Toledo, Ohio.

One of the warmest friends that Railway & Locomotive Engineering has ever had is Mr. W. D. Holland, a master mechanic, who likes to seclude himself in out-of-the-way countries for a few years, then return to the United States to recuperate for a few months. Wherever Mr. Holland goes he carries Railway & Locomotive Engineering along, recommends it to all the practical men likely to be interested in railway literature, and uses the advertising pages as a directory for ordinary supplies. Mr. Holland has recently accepted a position with the Caribbean Construction Company, with headquarters at Cape Haitien, Haiti, where they have begun the construction of a railway 450 miles long. We are certain that no better man than Mr. Holland could be found for the position.

William Schlafge.

Mr. William Schlafge, who has been appointed general mechanical superintendent of the Erie Railroad, with offices at New York City, was born in Berlin, Germany, October 11, 1868. During his early life he received a common school education, but in order to better equip himself, attended night school, using every means of self-help at his command to acquire a more liberal education. His first railroad experience was with the Lehigh Valley Railroad at Packerton, Pa., in minor capacities in the machine and car shops. Leaving that company in 1887, he went West, entering the Minneapolis, St. Paul & Sault Ste. Marie shops at Minneapolis as apprentice under instructions. After serving the required time he left this company and engaged in various railroad and contract shops as

WILLIAM SCHLAFGE.

mechanic and foreman. Entering the service of the Soo Line in 1893 as roundhouse foreman at Gladstone, Mich., he remained until 1898, when he resigned, going to the Escanaba & Lake Superior Railway, serving in the capacity of locomotive fireman, engineer and later on master mechanic. Realizing the opportunities on a small road were limited, Mr. Schlafge left the latter company, accepting a position as roundhouse foreman at Newark, Ohio, with the Baltimore & Ohio, and three years later was promoted to general foreman in charge of the locomotive and car departments, with office at Chicago Junction, Ohio. Resigning the last mentioned position he accepted service with the Erie Railroad as general foreman at Port Jervis, N. Y., March, 1903, and the following year was made master mechanic at Jersey City, N. J. In December, 1906, he was made master car builder of the Erie, with offices at Meadville, Pa., and then within the next few months general master mechanic and assistant mechanical superintendent, and in October, 1907, mechanical superintendent of the Erie Grand division and N. Y. S. & W. R. R., with offices at Jersey City, N. J., which position he held until his recent appointment as general mechanical superintendent of the Erie system. The Erie Railroad has so many officials competent to fill the position of general superintendent of motive power that there was difficulty in making a choice, and the decision is highly creditable to Mr. Schlafge.

OBITUARY.

RICHARD T. CRANE.

Richard T. Crane, head of the Crane Manufacturing Company, of Chicago, who has been an occasional contributor to RAILWAY AND LOCOMOTIVE ENGINEERING, died suddenly in Chicago last month, in the eightieth year of his age. Mr. Crane began life as a poor workman, and by energy, perseverance and good management built up a splendid business. He was the kind of man who refused to recognize the word fail. He accumulated a fortune estimated at $10,000,000, the greater part of which was left by will to public institutions or for benevolent purposes. He gave away something over a fifth of his fortune—$2,135,000 of a total property estimated at $10,000,000. Two million dollars of this total are to be used in two charitable schemes. The first million furnishes the endowment for a pension fund for the employees of the Crane Company, and the second goes to the establishment of a new pension enterprise—a fund for the support of dependent widows and women deserted by their husbands. The latter scheme includes, it is said, a manual training school for the fatherless children.

Mr. Crane did not have much respect for colleges, but evidently he believed in training schools. His widows' pension fund and associated school seems a novelty likely to have most useful and beneficent results. There are few unfortunates more pitiful and deserving of help than a mother and family of young children left penniless and helpless by the death or desertion of the husband and father.

Men fight to lose the battle, and the thing that they fought for comes about in spite of their defeat, and when it comes turns out to be not what they meant, and other men have to fight for what they meant under another name.—*William Morris.*

Hollow Staybolt Iron.

The increasing interest with which this material is being regarded by locomotive engineers has received marked stimulus owing to the fact that the United States Federal Government recently passed a law making a tell-tale hole compulsory in staybolts.

Staybolts produced from hollow charcoal iron make unfailing tell-tale on fractured or broken stays, and, furthermore, every hollow rolled stay possesses double the endurance of that made from the best solid iron. There is a danger in ordinary tell-tale drilling, owing to the fact that drilled telltale holes in staybolts have been found to be regularly stopped up, thus becoming a source of danger instead of an element of safety. Such a danger could not possibly exist in the case of Falls' hollow staybolts, as the passage of air currents through the entire stay prevent stoppage, and is a great advantage in combustion.

Many reasons may be given why hollow staybolt iron should be used in the construction and repair of boilers. Among these is the fact that they comply with the new federal boiler inspection law, requiring that all rigid stays have a 3/16 in. hole extending in them from the outer end, and that all solid stays be regularly inspected and condition recorded, and also while complying with the law, they save the expense and inconvenience of drilling tell-tale holes, avoid the weakness in the stay when drilled to one side or away from the center of the bolt, avoid the breakage of drills, and remove the necessity, delay and expense of hammer inspection.

The tell-tale hole is rolled throughout the entire length of the hollow bolt in the process of manufacture, and will therefore indicate a fracture by a slight leak at both ends, instead of at one end, as in the case of the drilled hole. The hollow stays never close up, while tell-tale holes drilled in solid stays invariably clog up with grease, sediment, etc., there being no air passing through the drilled hole to keep it open, as is the case with hollow bolts; moreover, the suction created by the exhaust of the locomotive tends to keep open the hole in the hollow stay.

Hollow bolts are automatically inspecting at all times, and are much more reliable than any human inspector, as they give warning immediately in case of breakage, by a little escaping steam at the end of the stay, while the best boiler inspectors are often deceived by uncertain sound or vibration of the sheet. The boilers equipped with hollow bar stays can never explode or collapse from broken staybolts, inasmuch as they compel attention before any dangerous number can be broken. The hollow rolled staybolt, being specially flexible, possesses double the durability of that made from solid iron, and more than double the life of the average stay when drilled for tell-tale.

The improved staybolts referred to are supplied by the Falls Hollow Staybolt Company, of Cuyahoga Falls, Ohio.

Vanadium.

A scientist addressing the members of an institute in Glasgow lately said:

"Pure vanadium is a silvery white metal of very high melting point—about 2,000 degrees Cent. Its specific gravity is somewhat low, i. e., 5.5. In some early experiments a mild steel free from phosphorus, with a tensile strength of thirty tons per square inch and 17 per cent. of elongation, was melted in a graphite crucible. It thereupon became carbonized and showed sixty-one tons tensile and 23 per cent. elongation. On adding 1 per cent. of vanadium the tensile was raised to sixty-nine tons with an elastic limit of fifty tons and 7.3 per cent. elongation. Ordinarily malleable iron of about twenty-four tons tensile and 19 per cent. elongation was changed by the addition of 0.5 per cent. of vanadium to thirty-nine tons tensile and 12 per cent. elongation in the forged bar, and 33.7 tensile with 32 per cent. elongation when annealed.

"These results proved remarkable malleability and ductility, and it was also found that it quenched hardened vanadium steels far more than it did ordinary carbon steels. The metal also allowed remarkable strength for cutting tools. A tool was made of the following composition: Carbon, 1.02; vanadium, 0.29, and would lend itself to resistance to the strains required in the same way that a natural knee for wooden ship construction is always stronger than one built up. With such steel no damage accrues by such simple bending, while the cost would be greatly less. In the normal way, to make a six-throw crank, weighing sixty pounds finished, something like a three-hundred-weight slab is operated upon, the metal removed being only scrap."

Prussian Railways.

We are advised by Mr. Julius Pintsch Aktiengesellschaft, Berlin, that the Prussian Minister of Public Works Von Breitenbach denies a report published in various European journals. This report stated that by action of the Reichstag at Berlin, the Prussian State Railways were to be equipped with electric light. This complete denial by the Prussian Minister of Public Works over his signature refutes any contemplated change from gas to electricity as an illuminant on the Prussian State Railways.

An Efficient Car Replacer.

The growing popularity of the Alexander pressed steel car replacer is the best proof of its efficiency. It has not only stood the test of time, but the fact that there are over 70,000 of them in use shows that railroad men appreciate the genuine article when it is called to their attention. The accompanying illustration shows the simplicity of the design, and while at the first glance it seems light to bear the weight of a derailed locomotive, it must be remembered that being made of steel 9/16 in. in thickness, it is capable of bearing 40,000 lbs., and has never been found wanting on any occasion that its service has been called into use. It does not require spiking, although spikes may be used as an extra precaution. The replacer is furnished with projections that under pressure sink slightly into the ties and form a solid bearing, and with their use the heaviest kinds of locomotives that have been unfortunate enough to jump the rails have been rerailed in less than twenty minutes.

REPLACERS IN POSITION. HIGH REPLACERS ON OUTSIDE OF RAIL.

Thousands of locomotives on the leading railroads have at least a pair of the Alexander replacers among the equipment, and even when not so equipped the lightness of the replacers is such that an ordinary man can readily carry two of them a considerable distance and facilitate the rerailment. Many of the leading coal companies have adopted them as standard, and in many industrial plants where curved or uneven tracks are the rule, their service is almost indispensable. The testimonials as to their efficiency are of the highest, and they are perhaps the only article of railroad equipment that never wears out. About twenty of the leading railroads in Amerca have more than a thousand of the Alexander replacers in use, and not a single complaint has been made in regard to the utility of the device. The enterprising company recently published an illustrated booklet showing the details in the construction and use of the replacer. Copies may be had on application addressed to the Alexander Car Replacer Manufacturing Company, Scranton, Pa.

Not So Very Fresh.

A Harvard professor noted for his severe way of examining students tackled a raw-looking freshman: "I understand you attend the class for mathematics?" "Yes." "How many sides has a circle?" "Two," said the student. "Indeed! What are they?" "An inside and outside!" was the prompt reply. "And you attend the moral philosophy class also?" "Yes." "Well, no doubt you heard lectures on various subjects. Did you ever hear one on cause and effect?" "Yes." "Does an effect ever go before a cause?" "Yes." "Give an instance?" "A barrow wheeled by a man!" The Doctor hastily sat down and put no more questions.

A Cinder in His Eye.

Indignant passenger to railway manager—"Here, I say, I got a cinder in my eye from one of your engines, and it cost me two dollars for a doctor to get it out. What do you propose to do in the matter?"

Manager—"Nothing, my dear sir. We have no use for the cinder, and you are perfectly welcome to it. No doubt you did get off with our property—the cinder, of course, was not yours—but we do not care to make a fuss about such a small matter."

Too Much Rehearsal.

Fred Lennox, spending the summer in Chicago, took a flat close to a railroad, which he surrendered after a week's occupancy.

"I think I could have become used to the trains going by in the night," he said, "but every morning at 8 two engines came under my window and rehearsed until noon."

Journal Boxes.

The Locomotive Equipment Company, of Detroit, Mich., have issued a finely illustrated catalogue in reference to their Newcomb journal boxes, which are meeting with much favor. The design of journal box is adapted to the standard pedestal, and arch bar, and in every way suited to the standard bearings and wedge, with the added improvements of dust guard, improved cover and means for controlling the lateral motion, as the slide of the car on its bearings. This latter device is an abutting disc that passes through the cover and is threaded so that in course of wearing it is adjustable and furnished with locking nuts. The use of this clever device is warmly appreciated by all who have seen it in operation. The dust guard is simple in construction, but admirably adapted to the purpose in view, and altogether the Newcomb journal box is an important addition to recent improvements in the details of rolling stock construction. The catalogue furnishes complete details both in illustration and letter press description, and copies should be in the hands of all interested.

Fexible Staybolts.

The universal approval that has been bestowed by all who have had the opportunity of testing the merits of the Tate flexible staybolt is such that it would require a number of volumes to present even an epitome of the forceful tributes to the efficiency of the flexible staybolt. It is pleasant to note, however, that Mr. E. E. D. Stafford has condensed the subject in the brief space of a 12-page bulletin, just issued by the Flannery Bolt Company, Pittburgh, Pa., and a perusal of which, taken together with the accompanying illustrations, form in the briefest manner imaginable explanatory matter at once illuminating and convincing. Send for a copy of this model bulletin to the company's offices, at 308 Frick Bldg., Pittsburgh. It will well repay perusal.

Twentieth Century Boring Tool.

In commenting on "The Twentieth Century Boring Tool" recently, Mr. A. M. Stickney, president of the Wellman Co., Medford, Mass., said: "This fine tool in justice to users of boring tools, is worthy of a few words of explanation because it is the only one of its kind. This tool is in a true sense an expansion tool; it has been designed, and is constructed, so as to make its use easy and sure. All other expansion boring tools on the market must be classed with those expansion tools where the expansion may be used to increase diameters of holes, but where its special use is to furnish increased diameter for grinding purposes. All these tools must be ground on centers to be true, but in the Twentieth Century tool

the cutters are taken out, ground and replaced. Every cutter fits each and every socket, so that they are replaced as they come. Should they not be radially correct with the center a set screw back of the tool is used to correct the position, a gauge being used for the purpose, the same indicating the diameter set for as well. Cutters cannot be changed about in other makes of so-called expansion tools; an attempt made very recently throwing the tool 7/32 in. out of center.

Then four cutters in the same plane give results not obtainable in any other system. Here we have stability, rotundity, and the minimum of power. Call to your minds the mechanical axiom that "The resistance to cutting is as the square of the thickness of the chip"; then calculate the power required for a coarse feed with one tool, then the same amount and weight cut with two tools, and finally with four. In many shops it has been found necessary to run through a hub twice in order to get the bore accurate. Recently a hole 6¼ in. in diameter, 7¼ in. long was bored through once with the Twentieth Century Boring Tool and the hole measured with a micrometer; the only variation found was a scant 1/1000 in. in the 7¼ inches.

In all other expansion boring tools reductions are obtained only by loosening up the cutters and pushing or driving them back into their sockets, and then moving out to the position required; that is, the micrometer will only register correctly one way. The Twentieth Century registers correctly whether the cutters are moved in or out.

There are other features which might be enumerated, but these lines are written only to interest and give correct information to users of boring tools.

Flatwist Drills.

The Cleveland Twist Drill Company have just issued a very artistic folder, the leading feature of which is a reproduction in miniature facsimile, of no less than twenty of the leading industrial magazines arranged in such display form as to present accounts of recent drilling records with Cleveland twist drills. These remarkable records were fully described in our columns in the August issue of last year, and we are pleased to observe that the opinions that we then expressed have been unanimously echoed by the leading industrial journals of the world. We may repeat what we then stated, that the Cleveland or "Paragon," high-speed drill established a new world's drilling record. It is a flatwist high-speed drill forged hot from the original bar in special dies, and has shown a capacity of cutting through 57½ inches of metal in one minute. Send for a copy of the folder to the Cleveland Twist Drill Company, Cleveland, Ohio.

Corroborated.

"Senator Dash, of Tallapoosa, prided himself on his rise from the bottom, for Senator Dash in his youth had worked with the colored men in the cotton fields.

"Boasting at a political meeting about his rise, the Senator singled out Uncle Calhoun Webster among his audience and said:

"'I see before me old Calhoun Webster, beside whom, in the broiling southern sun, I toiled day after day. Now, ladies and gentlemen, I appeal to Uncle Calhoun. Tell us all, uncle, was I, or was I not, a good man in the cotton fields?'

"'Yo' wuz a good man, Senatah,' the aged negro replied, 'yo' wuz a good man fo' a fack; but yo' sut'ny didn't work much.'"

Not Be Back.

A man left his umbrella in the stand in a hotel recently with a card bearing the following inscription attached to it: "This umbrella belongs to a man who can deal a blow of 250 pounds' weight. I shall be back in ten minutes. On returning to seek his property he found in its place a card thus inscribed: "This card was left here by a man who can run twelve miles an hour. I shall not be back."

Perfectly Safe.

Michael Dugan, a journeyman plumber, was sent by his employer to the Hightower mansion to repair a gas leak in the drawing room. When the butler admitted him he said to Dugan:

"You are requested to be careful of the floors. They have just been polished."

"They's no danger iv me slippin' on thim," replied Dugan. "I hov spikes in me shoes."

A Birth Mark.

She—"Oh, Tom, where did you get the black eye?"

He—"That's a birth mark."

She—"A birth mark? I never saw it before. What do you think caused it?"

He—"I got into the wrong berth on the Pere Marquette the other night."

Steel Car Forge Company.

The attention of general foremen and others responsible for making repairs at low cost to the production of the Steel Car Forge Company of Pittsburgh, that the new safety appliance standards of the Interstate Commerce Commission can be purchased from the Steel Car Forge Company; then they can be made in any railroad shop, and prompt delivery is assured. Make a note of the address and write for rates and you will never regret having done so.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXV. 114 Liberty Street, New York, March, 1912. No. 3

The Climax of Wireless Achievement.

A year ago Railway and Locomotive Engineering published a description of a wireless system of train control and the wide attention which this article attracted has caused the development of this invention to be watched with much interest. Many able engineers have held their minds in a solution of doubt which has now been dispelled by demonstrative facts the verity of which is beyond question. The age in which has been perfected the telephone, and the wireless telegraph, is an eminently consistent time to bring forth such a product of a master mind as this wireless train control; undoubtedly the most important development in the railway field since the introduction of the air brake.

Mr. Frank Wyatt Prentice, the inventor, has achieved wonders with this "Spooky" agent, the wireless force, and after a strenuous period extending over some fifteen years and at a cost of something over One Hundred and Fifty Thousand Dollars, has, at the prime of his manhood, realized the dream of his younger days. Today Mr. Prentice stands in the limelight of public opinion, a modest, unassuming Colossus of power.

The public has long groaned when it read of repeated railway disasters and people have clamored for a system which would eliminate the glaring reasons for these oft repeated accidents. "The storm prevented the engineer from seeing the signal," "The rear flagman was not at his post, having fallen down the embankment," and many other "reasons" which, when summed up, really amount to the fact that all has depended upon a visual signal, and if someone failed to recognize the signal, or if someone failed in his duty, the inevitable result of one individual's act was the endangering of human life.

A visual (or ordinary block signal) depends upon someone seeing something and then doing something. The Prentice wireless system depends upon no one for safety, as the system itself is a continual signal of safety, and anything which is not normal is danger. It is absolutely out of the power of any engineer to operate his train if anything is wrong, whether it be an open switch or derangement of the system itself.

A short time since Mr. Prentice arranged with our Consulting Engineer, Mr. Allen G. Wood, to conduct a thorough and exhaustive trial of this system. Accordingly, with the co-operation of Dr. Angus Sinclair, our Mr. Wood went to Toronto and, a few days prior to the test, walked over the Canadian Pacific line from West Toronto to Parkdale. A portion of the railroad company's lines between these two points consists of double track for a distance of two miles, and a more appropriate place for the development and the commercializing of

ENGINE SHOWING CONTROL BOX ON RUNNING BOARD.

a train control system could not be found upon the American Continent. This is true from an engineering point of view as well as from an operating standpoint.

During each 24 hours some thirty passenger trains and a large number of freights use these tracks. There is a grade of very nearly one per cent. west bound, and on the east bound this grade feature is very advantageous in attaining a high rate of speed. On both sides of the track are numerous telephone, telegraph and high tension feed wires. Two metal bridges are also on this section, as well as two overhead metallic crossings. About midway of this two-mile stretch is a curve of the usual C. P. R. proportions. The installation of the wireless train

ASBESTOS BOARD BLOCK STATION.

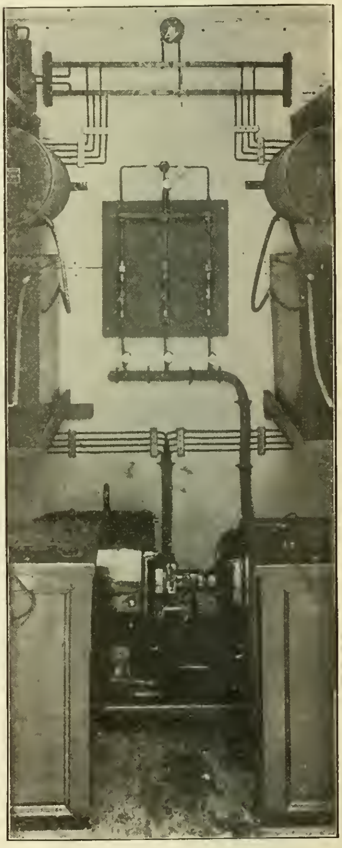
control system on this two miles, divides the track into sections or blocks, the blocks varying in length from 2,500 to 4,500 ft., four blocks on each track. The blocks are separated one from the other by the usual method of insulated joints. A wooden trunking containing the wires is laid midway between the rails and runs the length of each block. At the end of each block is a generator of wireless waves of very high frequency. This generator of wireless waves is con-

TRACK SECTION SHOWING WAVE-WIRE TRUNKING.

trolled by the alternating track circuits of the block in advance, and as long as the block in advance is not short circuited or broken, the wave generator which it controls is sending the high frequency wireless waves along the block in the rear. A broken rail or open switch will stop the wave generator which it controls, thus placing the block in the rear at danger, by the absence of the wave.

On the engine, which is equipped with the receiving apparatus, are four harps or antennæ. The two main harps are located one under the center of the engine, and the other under the tender, the one under the engine being 16 ft. long, and the one under the tender 12 ft. long. These harps each contain 12 copper wires and are suspended about 8½ ins. above the trunking in the center of the track. There are also two other antennæ known as the counterpoise or pickup antennæ, located one under the right hand steam chest of the engine and the other on the left side between the axle boxes of the tender. These harps are raised the same distance above the track as those under the center of the engine. Connected to these harps are highly insulated wires which run to the engine apparatus located on the running board of the engine, immediately in front of the cab. These wires are connected with tuning coils to which are connected the wireless wave responder. This responder being the latest novelty in wireless work is the invention of Professor Thomas E. Clark, of Detroit, Mich., and is, without doubt, the most wonderful achievement in wireless discoveries since Hertz discovered the wave. The relay responder is the only one known to work directly upon the wave without the intermediary of a coherer or microphone receiver. The responder operates the master relay, which in turn energizes the solenoids and controlling valves on the whistle line in the cab, the train line valve, the air brake system and bull's-eye flashlights located in front of the engineer in the cab. The energy for the engine apparatus is supplied by two 250 ampere hour storage batteries which have, to be renewed about once in three weeks.

In order to show the workings of the system and the perfect control of trains operated under various conditions, a trial was made in the following manner: A mixed train of thirteen cars was made up at the Simcoe street yard and drew onto the line, passing Parkdale at an estimated speed of 20 miles per hour, the red light showing and the whistle sounding. When the train passed onto the pickup wire at Parkdale subway the whistle in the cab ceased blowing, the red light went out and the green light was shown in the bull's-eye. The speed was gradually increased as the grade was climbed until an estimated speed of 45 miles per hour was attained. By this time the train was in the Wallace avenue block, near Bloor street, when a motor car



INTERIOR OF BLOCK STATION.

was purposely run into the block in advance at Royce avenue—this being the surprise danger test or signal. The green light extinguished, the red light illumined, the whistle started to blow, the train line valve was opened and automatically the brakes started to

apply. During all this time the throttle was wide open, the steam gauge registering 180 lbs., the engineer's air brake valve being in the running position. The air brake gauge showed a gradual reduction in the train line of 18 lbs. in 30 seconds and the train was brought to a standstill in 35 rail lengths. The service button in the cab was then pushed and the train line was closed, but the red light and the whistle still continued to give the danger warning. In 45 seconds thereafter the train line picked up and the gauge again showed 70 lbs. pressure on the train line. The engine was then started and run through to West Toronto, the whistle blowing and the red light glowing. The train was then run onto the east bound track and upon entering the first block at Royce avenue the wave was picked up, the red light extinguished, the green light glowed in its place and the whistle stopped blowing. In this block 2,000 ft. in length, a speed of 40 miles an hour was attained. At Wallace avenue the second block was entered and when half way through this block the whistle started to blow, the red light was shown and the brakes applied. The speed of the train was automatically brought down to 10 miles an hour when the push button was used, closing the train line valve, and the train was run at a speed of 5 miles an hour to Hurst's siding, where it was found that the switch leading to the main line had been purposely opened, giving the danger condition, as above.

The switch was closed and the train backed to Golden avenue, the beginning of the block in which the switch is located, where the engine apparatus was again automatically put into the safety condition by the operation of the wave. The train was then started down the one per cent. grade and when passing out of the wave zone at Landsdowne avenue, was evidently making 60 miles an hour. Within a distance of 1,000 feet the train was brought to a standstill by the operation of the system, the throttle being wide open with 195 lbs. of steam on the boiler, the whistle blowing and the red light showing in the cab.

The maintenance of this system, per block, since the first of June, 1911, as shown by records, has been five cents per day, power being purchased from the Toronto Electric Light Company. With generating plants, such as will be used on the railroad installations when adopted by the companies, it is estimated that a saving of 60 per cent. will be made in maintenance cost, or about 2 cents per day, per block. This includes the cost of power necessary to operate the system and the maintenance. The cost of installing the engine apparatus varies from $250 to $500 per engine, depending upon the class of engine. The cost of installation on the track is about the same per mile as for visual block signaling, the maintenance being estimated at 80 per cent. less than for visual block signals.

Some of the best authorities in the world have passed favorably upon this system of train control, and abundant assurance for business is evident as soon as estimates can be prepared. It is expected that the Canadian Railway Commission will soon make public their official report upon this device. The system is fully protected by numerous patents in twenty-five different countries, and it would seem that the ever-prevailing cry for a system which will safeguard a train, even though the engine driver may be unconscious, has at last been answered.

FRANK WYATT PRENTICE.

Accidents to Wooden and to Steel Cars.

Since railway companies have entered seriously into the practice of introducing steel cars, the people interested financially in the material used in the construction of wooden cars have been spreading predictions that steel cars would prove more distructive to human life in case of such accidents as collisions than the wooden cars, whose days seemed to be numbered. The theory advanced was that the steel cars would buckle up like a collapsed bird cage and that the unfortunate inmates would fare worse than passengers do in a wooden car that has met with a collision. With certain limitations wooden cars can be made as strong to resist shocks as steel cars, but the mere resisting shock without collapse does not cover the case. The fatal accidents in wrecks of wooden cars have not been due so much to the vehicles collapsing and squeezing the inmates to death as it has been by flying fragments of the wooden cars acting as murderous missiles no less dangerous than a gun shot. Horrible results have been due to wooden cars catching fire and burning up the passengers, but such accidents, although appalling, have not claimed so much human life as the splinters that spread disaster inside a fractured wooden car.

Theorizing concerning the difference of behavior of a wooden and steel car in a wreck is not of much practical value; but unfortunately during the last month there have been several very serious accidents to trains consisting of steel cars from which we can compare the relative value of the two species of cars so far as the safety of the passengers is involved. In one case, which may be considered representative, a fast express train was derailed through an obstruction on the track and all the cars were hurled down an embankment 30 ft. deep. An old style train would have been utterly wrecked and demolished by such a fall, and the loss of life from the collapse of the cars and from fire might well have been terrific.

This modern train of steel cars, to the contrary, held together marvelously. None of the cars buckled under the tremendous twisting strain and impact, and the only damage to them was that the trucks were driven through the floors in two cases. Only three passengers were killed, and half of the passengers were not even slightly injured. There was, of course, no fire, and considering the character of the accident the number of casualties was exceedingly light. It would seem as if the all-steel train had gone far toward proving its value as a safety appliance of the first rank.

The Chicago & Northwestern Railway Company are augmenting their forces at Boone, Ia., by the recent employment of 20 machinists, 20 machinists' helpers, 5 boiler makers and 5 boiler makers' helpers, blacksmiths and blacksmiths' helpers, gang bosses, pipe fitters, etc. The addition in number of men employed is about 80. The new shops are working nine (9) hours per day.

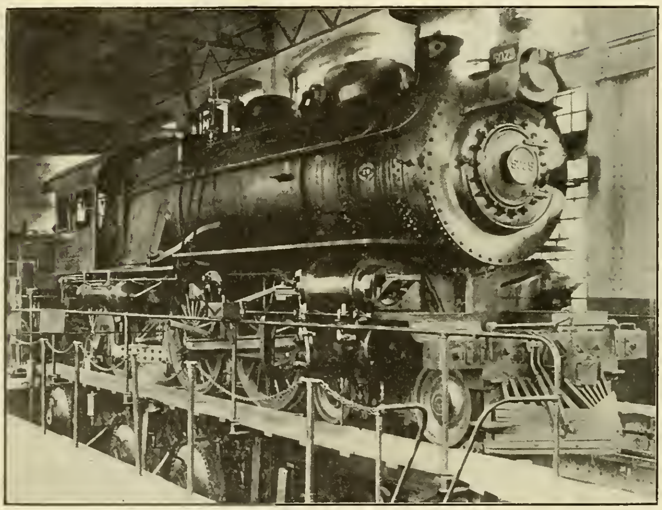
To make a good mechanic, the head and heart and hand must work together. That rule holds good with all classes of railway men from the trackman to the president. The heart desires, the head plans and the hands execute. Along with that rule it is well to observe another wise injunction: Whatever thy hand findeth to do, do it with all thy might.

Firing Tests.

Recent tests of locomotive boilers by the Pennsylvania Railroad Company at the testing plant at Altoona, Pa., resulted in some new and interesting data in regard to temperatures and air consumption in combustion in locomotive fireboxes. It was shown by repeated tests that the firebox temperature varies from 1,700 deg. to 2,300 deg. Fah., and the smokebox temperature varies from about 500 deg. to 750 deg. Fah., according to the rate of firing. In the burning of coal it was also demonstrated that when 58.2 pounds of coal was burned, 933 pounds of gas was produced per square foot of grate per hour. This shows how large an effect the air has in the performance of the boiler. This proportion, however, is variable. At a low rate of power 21 pounds of gas are produced from each pound of coal. At medium power 19 pounds of gas are produced, and at a high power 16.6 pounds are produced from each pound of coal.

It was readily noted that as the depth of the fire increased it became more and more difficult to get sufficient air through the grates. It will thus be seen that the rate at which the air is supplied is of the greatest importance in the economy of a locomotive boiler. Combustion, temperature, heat in the flues and smokebox, and the entire heating surface are all controlled by the amount of air admitted to the firebox.

It is, therefore, desirable to admit plenty of air to the firebox. With a given volume of firebox space, the more air supplied per pound of coal the greater will be the chances of completely burning the coal. Under the best conditions in locomotive service the tests showed that the heat radiated is usually between 25 and 35 per cent. of the heat produced, and in some high power tests, or where the firebox surface is small the percentage of radiation fell even lower. The facts deduced from the series of tests are all of interest, but the most important is the fact that for the first time available data have been secured as to the amount of air consumed by a modern American locomotive.



TESTING PLANT OF THE PENNSYLVANIA AT ALTOONA, PA.

Modern Heroism.

From a railroad standpoint, it is often questioned whether a man has nerve or the lack of it that makes him face any emergency as cool as if he were only sitting down to his dinner.

Is it the absence of nerves or the control of them? We are inclined to think it is the latter. Many a man who has acted the cool hero in a fatal catastrophe, has found himself prostrated by nerve exhaustion the next day. This kind of man has the first physical requisite for successful engineers, and to this nervy control of themselves many a trainload of passengers owe their lives or limbs.

Not long since a brother engineer pointed out a man on the street, and said: "There is the nerviest man in the State. Why, he could cut your heart out and hold it in his teeth and sew up the hole, if he thought it was best for you or the community, but he would be sick next day. Two years ago he was running the snow plow engine and struck a lot of ice at a tank siding on the A—— branch turned over and had a narrow escape. After steam blew off, he found the fireman was under the tank and had his leg badly crushed, and was pinned down by the tank flange. Most men would have been crazy and gone for help; not he. He took in the whole situation at a glance. He crawled under, and found the fireman was stunned by the shock and had a very bad leg. Instead of trying to bring him to to thrash around in his frenzy to get out, he just made sure he was alive and crawled out. Then he made sure that nothing could take fire, and then went and threw the switch at each of the sidings, so that no train could run into the wreck. On returning, he built a fire; there was no house for over three miles, and no train due for nearly four hours. Then he went under the tank and got his fireman roused up, and then did something few people would have thought of. He took his knife and stripped the pants of the fireman's crippled leg, took a piece of the bell cord and tied around the limb above the knee and twisted a stick into it. Then he cut off the leg where the tank had it crushed onto the frozen ground. Well, he worked a long time, and finally got him loose, wrapped up the bloody stump in his own shirt and carried him out to the fire. He dared not leave the man, as it was bitter cold, so he made him as comfortable as he could on the cushions and clothes, and built a windbreak around and over him with a lot of new ties and kept the fire up. Never got scared a bit, and even talked that fireman into believing he wasn't so terribly hurt anyhow, and kept his spirits up till a train came.

It was my train that got there first, and what did I find? The fireman's arms around Jim's neck, and Jim in a dead faint; yet he was standing by the fire when I struck the lower switch, and he was the sickest man of the two for the next month. Why, he tells me it makes him kind of sick just to see blood. Now that is what I call nerve. Oh, the fireman got along all right and is running the stationary over at the shop."

Helping Along.

Lord Palmerston, once Prime Minister of Great Britain, in addressing a meeting of farmers, said: "The man who makes two blades of grass grow where only one blade grew before is a real benefactor of his country." That was a homely illustration of what enterprise does which is applicable to many realms of industry besides farming. It is like the familiar proverb, "A stitch in time saves nine." The truth of both of these proverbs is daily illustrated in railway life and needs no demonstration to people of observing habits.

A reasonable return on capital is one which under honest accounting and responsible management will attract the amount of investor's money needed for the development of our railroad facilities.

General Correspondence

Trailer Box and Driving Wheel Hub Liners.

Editor:

Enclosed are sketches of two holders. One for facing off-trailer box liners, and one for machining driving wheel hub liners.

Fig. 1 represents top view of brass trailer box liner. Fig. 2 shows holder, and Fig. 3 represents side view of same. Fig. 4 represents holder in place on boring mill, with liner bolted on same ready for machining. Fig. 5 represents top view of holder for holding driving wheel hub liners for machining same. Fig. 6 represents side view of Fig. 5.

In explaining the method of using these holders, the holder is clamped down on boring mill by three finger clamps. The holes through top of holder are a trifle larger than the size of holes tapped out in liner to be machined. The holes in piece to be machined are laid off by using the holder as a templet and then drilled and tapped. The liner is then placed on the holder and short tap bolts slipped through the holder and screwed into liner to hold same down firm on the holder. Bolts a trifle shorter than the finish thickness of liner should be used. The top of liner is then faced off and then reversed on holder and finished to proper thickness.

In machining driving wheel hub liners

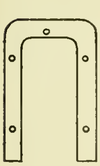


FIG. 1.

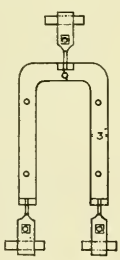


FIG. 2.

FIG. 3.

the inside diameter and also the outside diameter are being finished by one head, while the top surface is being machined by the opposite head.

The tapped holes in liner can be re-drilled and used for hub liner bolt holes if desired. The time saved in machining these castings, as above described, saves two-thirds of the time ordinarily used when trailer box liners were machined on planer, and driving wheel liners were machined by chucking in lathe.

The liners machined by the above method will be the same thickness at all points, as the top of the holder, as well as the bottom of the feet of same, are faced true. The inside diameter of holder for driving wheel liner is a trifle larger than the finished face of liner, and the outside diameter is smaller than the finished outside diameter of liner. The inside and outside diameters will depend

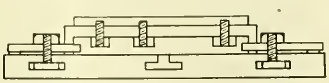


FIG. 4.

upon the dimensions of liner to be machined. These holders are being used to great advantage here by our company.

J. W. Percy.

South Tacoma, Wash.

Superheated Steam.

Editor:

I wish to comment on Mr. Schmidt's article in your January number on Superheating.

Mr. Schmidt argues that because of the greater economy the superheater has, there must be an increase in pressure in the superheater pipes. There may be some very slight increase in pressure, but it cannot be more than a pound or so, or the pressure would even up, and such a difference can have no effect on the economy. If Mr. Schmidt will consider, I think he will see that the great increase in economy is due to the absence of condensation in the cylinders.

In the ordinary engine the expansion curve will not correspond, even approximately with the PU-RT law, but there will be a rapid falling off in pressure toward the end of the stroke, due to condensation, as the temperature of the expanding steam falls below the boiling point of water at the pressure then existing. On the other hand, steam, the temperature of which is 100 deg. or more above its condensing point, expands a great deal before condensing, and its expansion curve will correspond very nearly to the PU-RT, which means more power for the same amount of steam used, or we can use an earlier cut off and get the same power, or larger cylinders, earlier cut-off, same amount of steam and more power.

Another point—maximum efficiency is attained when the number of degrees superheat is just such that steam will be just on point of condensing when exhausted, either fewer degrees of superheat, or more degrees of superheat give less efficiency.

Indianapolis, Ind. A. L. Sheridan.

Remembering Orders.

Editor:

The writer was riding on a locomotive some time since when the engineer got an important and complicated order. He read it over a couple of times to himself and said to the fireman: "Don't let me forget my orders." The fireman said nothing, and we steamed out. Ten minutes later the engineer whistled for the next station. "Don't forget those orders," said the fireman. "Allright," said the engineer. At the next station this was repeated, and so it was at the third and fourth; at the fifth the engineer showed some sign of annoyance, and finally said: "Got the do-not for the springs." The springs was several stations away yet, and the fireman was mute till we got there.

Now how much better it would have been had the engineer given the fireman the order to read, and read it to him; by so doing he would have made him an interested partner in his own responsibility; he would have acknowledged him as an intelligent workman, as an apprentice; he would have lessened his own danger and had the help of an ever alert lieutenant. Engineers cannot do a better thing than

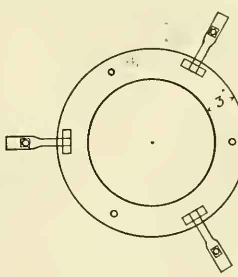


FIG. 5.

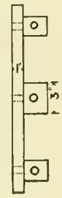


FIG. 6.

to reform the close-communion train order system. Put up a hook and hang every order on it and tell the fireman to read them as soon after they are received as possible. You will feel better as an engineer, the fireman will be proud of your confidence, the company will have more perfect and intelligent service, and the public more safety, and there will be fewer forgotten orders.

Foreman.

Chicago, Ill.

4-4-2 Locomotive Models.

Editor:

Locomotive models are coming rapidly into vogue, and it looks as if they will soon be one of the leading features at exhibitions and places of amusement. We have one running here that attracts much attention. It is of the Atlantic or 4-4-2 type. Some of the dimensions are: Length over all, 41 ins.; diameter of driving wheels, 4½ ins.; diameter of boiler, 4½ ins.; gauge, 3¼ ins.; weight, 20 lbs. The engine is propelled by a powerful electric motor and maintains a speed of 8 miles an hour. As a grade climber it beats anything I have ever seen. It is observable, however, that it does not start at the bottom of the grade, the hilly part being an incident in its journey, over which, no doubt the acquired momentum helps it to reach the summit.

Sunbury, Conn. A. D. Emery.

A 4-4-2 LOCOMOTIVE MODEL.

The Principle of Corrugation.

Editor:

It will no doubt be of interest to your readers, that since I made a series of tests some five years ago, on the formation of corrugations for locomotive fireboxes and tube plates, it has been proved that this formation is considerably over 60 per cent. stronger than the flat steel plates when made up into fireboxes and tube plates. Also since these tests, the principle of corrugation has been adopted for many devices, for now we see corrugated culvert covers, sewer pipes, telegraph poles, railroad ties, rods for reinforcing concrete work, even carrying it as far as paper for packing, and heavy wall papers, etc., all of which is no doubt due to the fact of its extra strength and neutralizing effect on changes of temperatures.

But it is to be remarked that the interest of motive power has been retarded, no doubt by the experiments in this direction, made with crude tools some 25 years ago, and only applied to one part of a firebox, and this without having made any tests as to the exact depth of formation to give the desired relief to the bound up forces in a firebox, and with no formation in tube plates to relieve the effects of cracking due to unequal expansion and contraction of flues. It is a fact that might be noted, that the principles set forth have been taken advantage of by many, and the gratifying results I have obtained in testing out locomotives with my improvements in corrugated fireboxes and tube plates can leave no doubt in my mind, nor in the minds of any well proven engineers, that sooner or later my plans must be adopted by all railroads on account of the reduced cost in maintenance, as proved by their working.

Wm. H. Wood,
Constructing Engineer.
Media, Del. Co., Pa.

Piermont—Not Clermont.

Editor:

On page 71 of the February number of Railway and Locomotive Engineering appears an article headed, "When Minot was Superintendent of the Erie," in which "Clermont" is named as the Eastern terminus of this road. That is a mistake, the Eastern terminus having been "Piermont." J. Shaw.

Sacramento, Cal., February 17, 1912.

[We acknowledge the correction with due humility, and confess that the mistake represents an instant of aberration on the part of the writer. On the first of February, when the paper was delivered in New York City, an old reader walked into this office and exclaimed "Where is the special instructor of the Erie who calls the historic Piermont, Clermont?" Since that day letters have been pouring in from all quarters of the country directing attention to the blunder. We thank our correspondents for their attention and feel gratified at the manifestation of how intelligently the paper is read.—Ed.]

More Superheated Steam.

Editor:

I have been reading the various articles in your esteemed paper on Superheated Locomotives and I wish to call your attention to errors in the article contributed by A. J. Schmidt in January, 1912, number. He says the 21-inch cylinder engine presents for each application of energy 346 sq. ins. of surface, and if you say you get 80 per cent. pressure you would have $80 \times 168 = 57{,}128$ lbs. energy. This should be $.80 \times 210 \times 346 = 58{,}128$ lbs. energy. He also says the superheater engine has 405 sq. ins. of piston surface for each alternating application of 80 per cent. of 165. This should be 415 sq. ins. of piston surface for each alternating application of 80 per cent. of 165, which would be $.80 \times 165 \times 415 = 54{,}780$. I find these articles very interesting and am looking forward with much pleasure for still further information on this subject. It is a very important improvement in the use of steam, and its universal adoption on locomotives seems a foregone conclusion.

Hamilton, Ont. Thos. M. Bond.

A Lackawanna Eight Wheeler.

Editor:

I enclose a small photograph of an American locomotive, the type of which has seen some constructive changes. A number of them were built by my grandfather at Kingston, Pa., at the Lackawanna and Bloomsburg shops as far back as the Centennial year, and rebuilt with new designs of fireboxes later in the century. The one that the photograph represents was rebuilt by my father in 1896, and is still doing excellent service. The facilities for construction or repair work were not so near perfection in those days, but the element of durability seems to have entered as largely into the work.

I would be glad to exchange photographs of Lackawanna locomotives with any of your readers who may have photographs of Philadelphia and Reading engines. Stewart Graham.

Scranton, Pa.

A LACKAWANNA EIGHT-WHEELER THAT HAS SERVED THREE GENERATIONS.

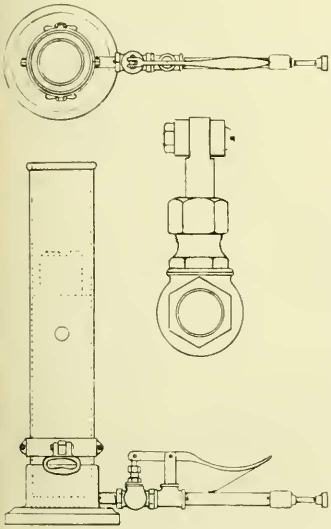
The Locomotive Cab.

Editor:

Your article in the February issue on "The Locomotive Cab" has revived in me some recollections on that subject. I have no idea by whom, why or when the first cab was put on a locomotive engine. In the early 40's the engines on the P. & R. R. R. had no cabs. An engine called the Manatany (built by Norris) was put in the shop for repairs; and cab was put on her—simply 4 stanchions—boarded 3 feet high on sides; with roof and side curtains, and windows across the front. When it was put in service the engineer refused to run her; as did several others. The objection was they were afraid to be shut in and killed in case of accident. Finally a man, to whom I afterwards fired, Pat Fagan, took her, and in a few days every engineer wanted a cab on his engine.

The only cab that I ever saw, or heard of, was on an engine built by Ross Winans about 1856 for passenger service on the P. & R. R. R.; it was called "Celeste." Her cab was on a platform in front of the smoke box, thus giving the engineer an uninterrupted view not only ahead but on both sides. If by any chance there was an obstruction of any kind on the other track Celeste's engineer would be apt to see it, and warn the man on his way of the danger ahead. On English railways also, I am told, trains run on the

right hand track, but the engineer has his place on the left side of the engine. It is also the same with carriages and heavy teams. In this country the drivers of heavy mountain teams ride the "near" or left-hand horse. E. J. RAUCH.
New York, N. Y.



DETAILS OF AIR SLEDGE.

Air Sledge.

Editor:

Attached is a drawing showing a home-made air sledge which is constructed from a 4-in. pipe about 2 ft. in length and operated by a globe valve furnished with a lever-operated valve, which gives quick opening to the air inlet and automatically closes by a spring attached under the handle. This sledge has proved itself to be very effective in removing refractory bolts, and is much valued by the men of the wrecking crew, as it has been very effective in removing draw-bar pins where the tender and engine were jammed together. The device has the double merit of being simple in construction and operation. CHARLES MARKEL,
Shop Foreman C. & N. W. R. R.
Clinton, Ia.

Lubricating Valves and Cylinders.

Editor:

The accompanying print shows the general arrangement and principal details of a device, recently patented, for the successful lubrication of valves and cylinders of locomotives using superheated steam.

All locomotive runners know from experience, the impossibility of lubricating valves successfully when the locomotive is being run in short cut-off and with full throttle, especially on up grades; this causes much trouble to the runner, and materially reduces the efficiency of the locomotive's power. And since the advent of superheated steam, the question of perfect lubrication of valves has become a serious proposition, because of the fact of the increased difficulty in and the greater importance of lubricating them.

To the skilled mechanical officials of the many railroad systems, this is a well-known fact and is easily accounted for, namely, the high pressure, together with the high temperature, which destroys a large percentage of the oil used for lubricating purposes.

This device is intended and designed to overcome these difficulties, and the results are easily and surely accomplished, as will appear from an inspection and study of the enclosed print. By the oil traveling through stationary pipe (22), connected to lubricator, which pipe extends through hollow tube (23), clamped to cross-head (4) and screwed into piston head (19), making a sliding connection. The oil then flows through passage (16) to a point in top of piston head, thus converting space (1) between packing rings, into an oil chamber. Then again, oil entering pipe (15), which is clamped on bracket connected to top guide or some more convenient place, the oil flowing through passages (12 and 11), which open up between packing rings of the valves.

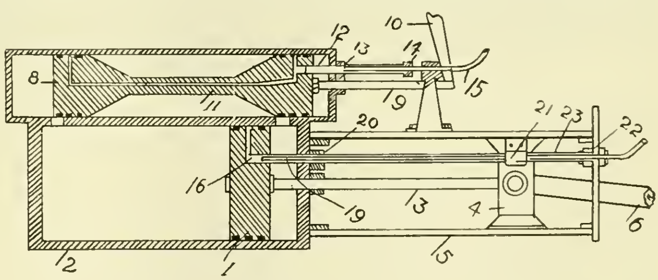
From the above description it is clearly seen that the oil, in its travel, does not engage either the high pressure or the high temperature of the steam, and that this device distributes the oil over the bearings, no matter in what manner the engine is being worked; and there is neither loss or depreciation of the oil as a lubricant by reason of it engaging either the high temperature or pressure.

With the common angle tee connected to lubricator and then to oil pipe, with live steam admitted through a connection with some convenient steam pipe on boiler head, insures almost instantaneous application of the oil direct to the bearings in contact.

I wish to add in connection with this article, that my device for lubricating slide valves, shown in your January issue, has just completed a two years' service test, the results of which did not reach me until after the publication of the article, and I wish to add that it has proven all and more than was claimed for it.

Complete details of the devices will be furnished on application, to any one interested in the economical operation of the locomotive, which can only be accomplished through perfect lubrication of its valves.

DAVID MOREHOUSE.
Villa Grove, Ill.



LUBRICATING DEVICE FOR VALVES AND CYLINDERS.

Tests of Valve Travel and Inside Lap.

There used to be on the Chicago, Burlington & Quincy locomotives of the same general dimensions that had different throw of eccentrics, some of them 5 ins. and others 5½ ins. Some of them had ⅛ in. inside lap, others had no inside lap.

There was great difference of opinion among the engineers and master mechanics about the effect of the different dimensions and the superintendent of motive power ordered a thorough test of the locomotives by the test department. The tests consisted mostly of hauling a train of known weight up a steep grade. It was found that the small difference in the valve travel made no difference in the hauling capacity of the engines. It was, however, found in every case that the inside lap lessened the power of the engines without effecting any saving in steam.

The educational charts published from time to time by the Angus Sinclair Company, illustrating and naming all the parts of locomotives have imparted useful information to people beyond number, and they have proved useful reference to thousands of railway officials who have little knowledge of locomotive details. On some railways they are posted in all train dispatchers' offices and are used to report upon the nature of engine failures. A railroad club or school is not complete without them.

Creating Traffic.

At the annual dinner of the Central Railway, held in Buffalo January 11, Mr. W. G. Besler, general manager of the Jersey Central, acted as toastmaster, and Mr. P. R. Todd, vice-president of the Bangor & Aroostook Railroad, was the principal speaker.

After some facetious preliminary remarks, Mr. Todd said that a large proportion of the traffic carried by the railroads of this country was created by the railroads after months and sometimes years of toil to create it.

MAKING A WILDERNESS FERTILE.

When the Northern Pacific and some of the railroads in the Northwest, first constructed those lines, they went ahead of the people; they did not build into the centers of population, but built to create in time those centers. The way that they got population was by spending much money and energy in bringing from Europe chosen farmers. These men were contracted for in Europe, were brought to Minnesota and other States by representatives of these Western roads, thereby creating much traffic for Eastern lines. Farms were sold cheap to those immigrants, the men were taught how to cultivate the farms according to American methods, and it took several years before the products of these farms began to furnish traffic for the railroads.

WHAT THE TRAFFIC WILL BEAR.

Then when the traffic was ready to move, the question had to be considered as to what rates it was fair to charge to enable those men to market, at a profit, the product of their farms. From that arose the expression which has been so badly distorted, especially in the court, "All that the traffic will bear," which does not mean, and never did mean, every dollar that could be squeezed out of the shipper, but everything that the traffic could bear and give some profit to the railroads and to the producer.

CREATING HOLIDAY TRAVEL.

Another phase of created business is shown in the passenger department. The summer tourist business is one that did not exist twenty-five years ago. It has been entirely developed by the railroads through judicious advertising, creating first the desire in the hearts and minds of the people to take a vacation and then steering them to travel for a consideration in the proper direction.

PROFITABLE ADVERTISING.

Some ten years ago, when I was connected with the West Shore Railroad, Mr. Calloway, at that time president, gave us rather more than a liberal allowance for advertising, and by properly advertising the summer travel between New York and the Catskills in a three months' season, the travel was increased from 24,000 people of the previous season to 56,000 that year. That is creating business.

Take a center like Chicago, and it is wonderful how people, after reading alluring advertisements, will be induced to take a trip to Atlantic City, Coney Island, or Colorado. The desire to go somewhere is created by the railroad advertisements which are creating traffic.

MODERN METHODS.

Within the last five years the creation of new traffic has been a purpose with almost every railroad company. Up to that time it was largely a question of how much one railroad could get away from another railroad. But conditions have changed in that as in many other phases of railroading, and each railroad is now striving to build up business on its own road, trying to create it.

INTEND EXPLOITING NEW TERRITORY.

Coming to the railroad in Maine that I am now connected with, we are developing an entirely undeveloped country. We hope next year to start on the construction of a new line 150 miles in length, in which at the present time there are only fourteen inhabitants. We believe that five years after the construction is finished it will be one of the most profitable pieces of railroad in this country. But many things will have to be done in the meantime to create the traffic.

BESLER TEACHES HOUSEWIVES THE PLEASURE OF COAL BURNING.

Another illustration of creating traffic comes to this meeting. Our worthy toastmaster favored me with a week's visit three years ago up in Maine. After looking about for a day or two Mr. Besler was disgusted to find that everybody burned wood in their residences, which was bad for the coal market, in which he is interested. A coal agency was established, but there was no demand for coal. To create a demand they got spreading most alluring advertisements; and to whom did they address them? They addressed them to the farmers' wives, for no man gets up to attend a wood furnace in Maine if he has a wife. The result of the first year was the purchase of 40,000 tons of coal from the Jersey Central road, and that was only a beginning.

RAILROAD TOOK LUMBER BUSINESS AWAY FROM WATER.

Mr. Todd then proceeded to tell that when his line, the Bangor & Aroostook, was built to the St. Johns River, there were practically unlimited forests but no way of sawing the trees into lumber for commercial uses, because there was no way of getting the lumber to market. For years and years the trees were cut down into logs during the winter, floated down stream to the great rivers, and it took an average of two years to get them floated to St. John, N. B. The State authorities estimated that 60,000,000,000 feet of logs had been floated to St. John from Maine. The railroad company lost no time in making preparation to carry the lumber to market, as there are now seventy-three mills sawing lumber on the line.

UTILIZING WASTE MATERIAL.

The sawmills waste a tremendous amount of stuff. They waste more than they ship. The railroad company is the only interest that tries to utilize the waste. It keeps a man employed all the time to seek all over the country for manufacturers who will go up there and use up that waste; so that now there are factories that make the little bundles of kindling that you use in your homes. Before they were established two years ago, all this refuse lumber was thrown into the river or burned up in dangerous bonfires. Now, none of it is thrown into the river or burned. It is used up in a way that gives employment to a great many people and provides new freight for the railroad company.

MAKING WOODEN CROCKERY.

The next thing was to find use for small hardwoods. The greatest use found is the making of spools for thread, so that today there are six large mills engaged in making these spools, creating between 500 and 600 carloads of freight a year. Still that did not use up all the small hardwood refuse, and a recent thing that our commercial man has found is to make baseball bats for the national game; and, lastly, they are making wooden butter dishes for camping parties and wooden tea cups and things of that character—all of which creates freight and saves waste.

Steel Cars.

The experience which the Lehigh Valley Railroad has had in using all-steel cars for its passenger service has proved so satisfactory that it will now put into service trains consisting of all-steel cars from end to end. The company has just awarded contracts for the construction of 25 steel cars, including 15 combination baggage and mail cars, 60 ft. long, and 10 combination passenger and baggage cars have been ordered. Five of these 10, designed for long distance service, are to be 70 ft. long, with six-wheel trucks, while the other five will be 60 ft. long, with four-wheel trucks. The cars ordered are to be delivered at once.

Pacific Type of Locomotive for the A. T. & S. F. Railway

Among the more important recent additions to motive power, the Atchison, Topeka & Santa Fe Railway has developed a Pacific type locomotive which includes a number of interesting features. In developing this locomotive, the aim of the railway company has been to adhere to the general principles of its old power as far as practical, and yet introduce sufficient modification to overcome those weaknesses which had been detected.

The first six coupled locomotives with balanced compound cylinders placed in service on the Santa Fe were of the Pacific type. All four cylinders of these older engines are arranged in the same horizontal plane, and the engines equipped with bifurcated high pressure main rods spanning the front driving axle. The valves are operated by the Stephenson motion, with eccentrics on the third driving axle.

A few years later a different type of six coupled locomotive with balanced compound cylinders was placed in service on the Santa Fe. This was a Prairie type for fast freight service. In the locomotives of this type the inside or high pressure cylinders are inclined and raised to a sufficient height to permit a straight main rod to clear the front driving axle. The steam distribution is controlled by the Walschaerts valve motion.

Retaining these features, the design of the new locomotives was developed by the selection of parts common to existing engines, and principally from the type already mentioned.

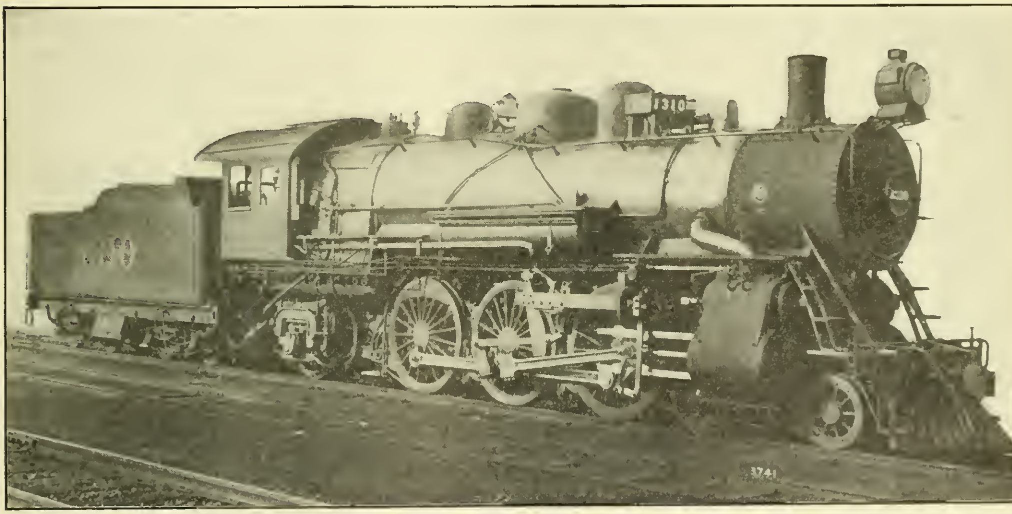
Twenty-eight of the new Pacific type have recently been built by the Baldwin Locomotive Works. Each locomotive develops a tractive force of 35,000 lbs. The boilers are fitted with Buck-Jacobs superheaters and fireboxes of the Jacobs-Shupert type. Six of the locomotives are equipped for burning oil, while the remaining twenty-two burn coal. The steam pipes are on the outside, where joints are accessible for inspection and repairs, and where possible leaks will not affect the steaming of the engine.

The outside, or low pressure guides are of the usual two-bar type, and are supported on cast steel bearers which are bolted to a transverse yoke. The inside, or low pressure guides are of the Laird type, this design being used in order to provide the necessary clearance above the leading driving axle. These guides are supported, at the front end, by the low pressure guide yoke, and at the back end by a cast steel frame brace, which is placed just behind the first driving axle and extends the full depth of the frame pedestals. The arrangement of high pressure guides has resulted from the railway's experience in overcoming cylinder head troubles on older engines.

The details of the valve gear, which is of the Walschaerts type, have several features which the railway has adopted to overcome some of the annoying failures which often result from negligence of small parts. Care has been taken to avoid offset bearings in valve motion parts in order to minimize the tendency to twist or buckle. All pins are made of ample size and are arranged in double shear. No detachable oil cups are used on any part of the valve gear.

Another of the small details revised for the benefit of the new engines is the trailer truck oil cellar. In this the lower portion of the cover casting and the cellar are cast in one piece. This eliminates joints in the cellar which permit oil to leak out.

The boilers used on all these locomotives are of the wagon-top type, with two steam domes. The rear dome is placed on the wagon-top, while the forward dome is located near the front end of the barrel. Steam is conveyed from the rear dome to the forward dome through a pair of 5-inch pipes. The forward dome contains the throttle, and as communication between its interior and the boiler is cut off by a plate, the steam supply for the cylinders is drawn entirely from the rear dome, which is at the highest part of the boiler. The throttle takes steam through the top only, and communicates with the external dry pipe. In the engines with Buck-Jacobs' superheaters, the superheating chamber is 37 ins. in length; its forward tube sheet being 24½ ins. back of the stack center line. An intermediate chamber is placed between the superheater and the main evaporating section of the boiler, and as this chamber can be entered through a manhole, the tube ends are easily accessible. The superheater tubes are welded into the tube sheet at the back end, and rolled at the



NEW PACIFIC TYPE OF LOCOMOTIVE FOR THE SANTA FE RAILWAY.

W. E. Buck, Supt. of Motive Power. Baldwin Locomotive Works, Builders.

front end. Steam enters the superheater on the top center line, and is guided by internal baffle plates, so that it follows a circuitous course among the tubes.

The following are the leading dimensions of the coal-burning locomotives equipped with Buck-Jacobs' and Schmidt superheater respectively:

Gauge, 4 ft. 8½ ins.; cylinders, 17 ins. and 29 ins. x 28 ins.; valves, balanced piston.

Boiler—Type, wagon top; material, steel; diameter, 70 ins.; thickness of sheets, 23/32 in., ¾ in., 13/16 in., ⅞ in.; working pressure, 210 lbs.

Firebox—Material, steel; length, 109⅝ ins.; width, 75¾ ins.; depth, 59½ ins.; thickness of sheets, sides, ⅜ in.; back, ⅜ in.; crown, ⅜ in.; tube, 9/16 in.

Water Space—Front, 5 ins.; sides, 5½ ins.; back, 5 ins.

Tubes—Material, iron; thickness, No. 11 W. G.; number, 290; diameter, 2¼ ins.; length, 18 ft. 2 ins.

Heating Surface—Firebox, 223 sq. ft.; tubes, 3,088 sq. ft.; firebrick tubes, 14 sq. ft.; total, 3,325 sq. ft.; grate area, 57.6 sq ft.

Driving Wheels—Diameter, outside, 73 ins.; diameter, center, 66 ins.; journals, main, 11 ins. x 10 ins.; journals, others, 9 ins. x 12 ins.

Engine Truck Wheels—Diameter, front, 34¼ ins.; journals, 6 ins. x 10 ins.; diameter, back, 50 ins.; journals, 8 ins. x 14 ins.

Wheel Base—Driving, 13 ft. 8 ins.; rigid, 13 ft. 8 ins.; total engine, 35 ft. 1 in.; total engine and tender, 66 ft. 9⅜ ins.

Weight—On driving wheels, 160,900 lbs.; on truck, front, 54,980 lbs.; on truck, back, 60,620 lbs.; total engine, 276,500 lbs.; total engine and tender, about 448,000 lbs.

Tender—Wheels, number, 8; wheels, diameter, 34¼ ins.; journals, 5½ ins. x 10 ins.; tank capacity, 9,000 gals.; fuel capacity, 12 tons; service, passenger.

A Novel Snow and Dust Remover.

A snow remover of a novel character has been invented and patented by J. W. Wersmantel, of Newark, N. J. The invention consists of a car carried on two four-wheel trucks equipped with a rotary brush for impelling the snow upon a carrier that conveys it upon plates heated by a gas furnace located inside of the car. The details of the snow remover have been worked out with much constructive skill. The arrangement of the apparatus are such that it can easily be converted into a dust collecting car for cleaning streets and roads.

According to calculations made by Mr. Slayson Thompson, the ordinary postal charge, if applied to the transportation of first-class mail matter by freight, would be sufficient to carry a ton of letters ten times round the earth at the average freight rate of 7.6 mills per ton-mile.

The Development of the Steam Engine

By ANGUS SINCLAIR

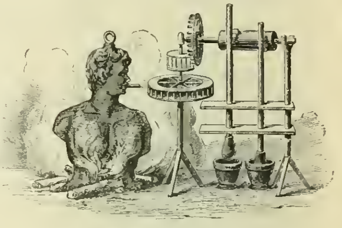
The steam engine is a modern invention, but attempts to invent apparatus that would perform work by the medium of heat are as old as civilization. There is now no means of knowing how long ago people began trying to use in different ways the force obtained from the expansion of steam; but it is certain that a primitive form of steam engine was shown as a curiosity in Alexandria, Egypt, two hundred years before the beginning of our era and was described as well as many other mechanical appliances by Hero of Alexandria, about 150 B. C.

There is good reason for believing that the philosophers of antiquity had made some progress in applying steam to mechanical purposes; but the wise men of ancient times were much more given to theorizing concerning scientific discoveries than they were of applying them to the service of mankind. In fact, most of them would have considered it degrading to have used their inventions or discoveries to lighten the burdens carried by their fellowmen. As long as the toil of producing food and clothing for the people was done by slaves, labor was regarded with contempt, and no consideration was given to the amelioration of toil.

The Romans appear to have been familiar with the principal elements constituting a steam engine; but they never devised the combinations necessary to chain them into a working machine. The spirit of utility was not sufficiently active to produce inventors who could have brough forth a practicable engine. Later on evil times fell upon the world, and the use of the sword almost annihilated all peaceful arts. During the long period of darkness, known as the Middle Ages, all sorts of inventive tendencies were suppressed, unless their purpose was perfecting weapons intended for the destruction of human life.

A long period of intellectual gloom followed the fall of the Roman Empire, which for a time comprised the world's civilization, and strangely enough the Saracens, who had taken the lead in destroying the records of learning and treasures of art in Alexandria, were the first to revive intellectual activity in Europe. After their brief career of proselyting conquest, the Arabian people devoted themselves to the pursuit of Greek philosophy and science. After the conquest of Spain by the Arabs, Andalusia became for a time the world's center of intellectual life. From the Greeks the Arabs obtained the principles of geometry and from the Hindus the science of algebra. In their hands spherical trigonometry was greatly developed, but their most valuable work was done in chemistry and other sciences readily developed by observation.

The learning that the Saracens had developed in Spain gradually extended to other countries in Europe, particularly to Italy, Germany and France. Theology interfered with scientific investigations and progress, but the most reactionary influences have moved in vain against intellectual activity. The practices connected with the study of chemistry led scientists into the habit of making experiments, as it was a short step from chemistry to physics or to the investigation of heat phenomena. Not, however, until the sixteenth century do we find men's minds working towards the utilization of heat for industrial purposes. About the beginning of the fifteenth century Leonardo da Vinci, the famous Italian artist and engineer, invented a steam gun, and in 1629 Giovanni Branca, another Italian, invented a steam turbine,



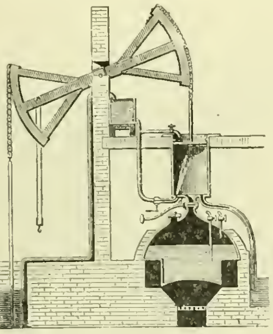
BRANCA'S ENGINE. 1629.

which needed only the exercise of a little mechanical skill to make it a rival of the piston-cylinder engine.

In continental countries there seemed to be no special demand for the concentrated power that a steam engine would supply, so that the experiments and speculations looking towards utilizing the expansive force of steam had no definite or profitable purpose in view. It soon became different in the British Isles. There mining was an active and profitable business. Coal pits, tin and other mines had been sunk deep into the bowels of the earth, and keeping them free from water with animal power was becoming an expensive operation. Heat was known to be convertible into power, so men began trying to invent a fire engine that would take the place of horses. In 1630 a patent was granted to David Ramsay, a Scot, who had followed the Stewart King to London, for an invention that was to perform many wonders, among them the raising of water from mines. Several other inventors patented fire engines for divers purposes, from moving ships to flying machines, but no practicable work was done until we come to the Marquis of Worcester, who, in 1663, published a

description of his inventions, which were principally used for raising water by steam. The Marquis of Worcester became so deeply interested in this line of invention, that he spent a fortune upon it. The general plan followed by Worcester and tried in different forms by many other inventors was to raise water by means of steam acting on the surface of water placed in a vessel that had a pipe connection with the atmosphere. The principle was the same as that used in sleeping cars to raise water by air pressure, with the difference that its tendency to condense made steam less efficient than air.

Thomas Savery, an English military engineer, born about 1650, became a very enthusiastic inventor of fire engines, and got some of them into service in draining mines and in supplying cities with water. A method of creating a vacuum, which was discovered by Porta, an Italian, in 1601, was used by Savery in



NEWCOMEN'S ENGINE. 1705.

connection with his apparatus for raising water by steam pressure.

Among others who labored on the development of the fire engine were Salomon de Caus, a French engineer, who became insane over the work. Dr. John Wilkins, bishop of Chester, England, who applied the ancient Nero apparatus to a smoke-jack and wanted to use it to drive a flying machine. In 1678 Jean Hautefeville, a French priest, invented several engines on paper, one of them to produce power by the gas from gunpowder or steam pressing upon a piston. That engine was not built, but in 1680 Christian Huyghens, a Dutchman invented a gas engine which operated a piston inside of a cylinder, an important invention, since it was not only the first real application of a piston inside of a cylinder, but was the prototype of the other gun engine. Dennys Papin, an expatriated French physicist, who devoted most ingenious attention to heat phenomena, invented a variety of boiler apparatus, among them a two-way cock, a jet condenser, the safety valve and gauge cocks.

By the beginning of the 18th century nearly all the elements that make up a modern steam engine had been invented or discovered, and it wanted only a master mind to couple them up into a chain of working mechanism. That mind seemed to be possessed by an obstinate English blacksmith named Thomas Newcomen. Newcomen was familiar with the attempts of Savery and others to use direct pressure engines to raise water, and came to believe that the use of a piston was necessary to make steam perform work with the greatest efficiency. Not having complete confidence in his own belief, Newcomen asked the advice of Dr. Hooke, the scientist, who had discovered the influence of pressure upon the boiling point, and was strongly advised to abandon the piston idea. Like many other inventors, who seek outside advice, Newcomen adhered to his own opinion, and in 1705 secured a patent for an atmospheric steam engine, having the combination of a piston working inside of a cylinder.

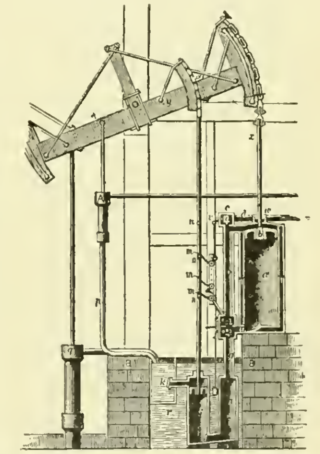
The engine was built by Newcomen and put to work in 1709. It was about as primitive a prime mover as could be conceived, consisting of a cylinder set above a small boiler and a piston with its rod operating upwards and connecting with a walking beam which actuated a pump rod on the other end. The upper end of the cylinder was open and a supply of water was kept running upon the piston to help in making it steam tight. A casing surrounded the cylinder, which at first held the water used to condense the steam. That was the first surface condenser. The beam to which the piston connected was so counterbalanced that it pulled the piston to the top of the cylinder.

The mode of operation was thus: The piston being at the top of the cylinder, connection between it and the boiler was made so that the cylinder was filled with steam, which was condensed by the cold water surrounding the cylinder and a vacuum created when the pressure of the atmosphere pushed down the piston, effecting a stroke. That was kept up indefinitely at the rate of about four strokes a minute. All opening of cocks and valves was done by hand.

One day the engine started off at the amazing speed of about ten strokes a minute, and on investigation the attendants found that a hole in the piston had permitted water to enter the cylinder, changing it from a surface to jet condenser. The hint that accident had given was used, and jet condensation became the regular practice with increased efficiency.

A boy named Humphrey Potter, who attended to opening and closing the valves, connected the valve handles by strings to the moving beam, in such a way that the valves were opened and closed by the motion of the engine, and that automatic motion increased the efficiency of the engine to 15 or sixteen strokes a minute. Henry Bighton, a mechanical engineer, who afterwards improved the engine, substituted rod and catch-pins for Potter's strings.

The next improver of the steam engine was John Smeaton, the celebrated engineer, who built the Eddystone lighthouse. In 1767 he had a small engine made for experimental purposes and made a series of tests to find out the best proportion of parts. During these tests he discovered the loss of steam that resulted from united cylinder condensation, the heat-wasting feature that afterwards induced Watt to apply a separate condenser, and subsequently a steam jacket to the cylinder. Smeaton was engaged for several years in the construction of Newcomen engines and turned out several very large ones, what was known as the Chase water



WATT'S ENGINE. 1769.

engine having had a cylinder 72 x 108 ins. It was at the best an imperfect form of steam engine, but it did the work of pumping water out of deep mines, which had become impractical for animal power. As the efficiency of the mechanics engaging in building these engines increased, steam pressure was augmented to about 7 pounds per square inch, which increased the efficiency of the engine.

Some time in 1763 James Watt, an instrument maker, of Glasgow, Scotland, was asked to repair a model of a Newcomen engine belonging to the University. Watt had made considerable progress in the study of heat phenomena before that time, so he naturally made tests of the model to find out its grade of efficiency. These demonstrated that serious loss of heat resulted from the practice of using the cylinder as a condenser. He tried various means to prevent cylinder condensation or to obviate the heat losses resulting therefrom; but finally decided that the only effectual remedy was to con-

dense the steam in a vessel separate from the main cylinder. This separate condenser was Watts' most important invention, and constitutes the main difference between an atmospheric steam engine and a low-pressure condensing steam engine.

In his experiment with the Newcomen model Watt demonstrated that heat losses arose from:

First, the dissipation of heat by the cylinder itself.

Second, the loss of heat consequent upon the necessity for cooling down the cylinder at every stroke.

Third, the loss of power due to the pressure of vapor beneath the piston, which was a consequence of the imperfect method of condensation.

In his invention of a steam engine having a separate condenser, Watt proceeded to carefully correct the defects of the Newcomen engine mentioned, and having wonderful inventive abilities he proceeded to effect the improvements that raised the engine from a mere pump operating apparatus to motive power adapted for all purposes. After designing the appliances that made the single acting engine thoroughly reliable, he made it double acting, and therefore both more powerful and more economical than the previous form. When that type was working satisfactorily he introduced the system of cutting off steam before the end of the stroke, securing the benefit of expanded steam. To ascertain the behavior of the steam in the cylinder he invented the steam engine indicator, the records of which induced him to introduce the use of steam jacketing as a means of preventing, or rather reducing, cylinder condensation.

Among other inventions devised by Watt was a steam hammer, a parallel motion, cross-head and guide, the puppet valve, fly-ball governor, the water gauge glass, the flywheel and a great many other devices.

The invention of Newcomen was the means of saving many mining properties from ruin by water and its tendency was to promote enterprise in running operations; the improvements that Watt effected upon the steam engine gradually stimulated every industry that depended upon mechanical power as a means of economical operation, and led to a magnificent advance in all branches of industry which in their turn carried onward a wave of literature, art and science unparalleled in the world's history. The steam engine as it left the hands of Watt was a ponderous slow-moving apparatus that was far from being economical of heat; but it proved a grand step towards the more perfect mediums of power that are now carrying the burdens of mankind.

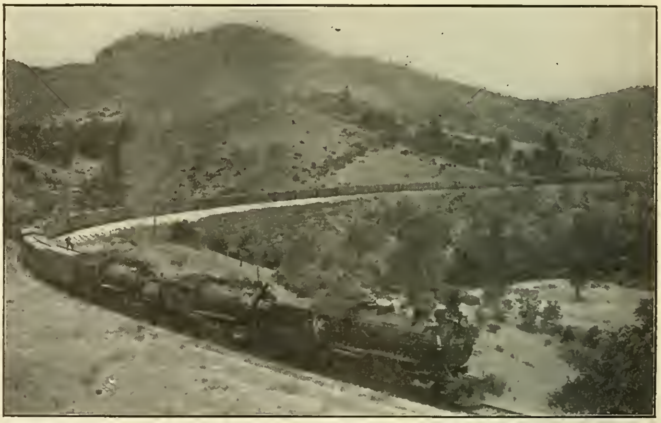
The locomotive and other high-speed, high-pressure engines were developed from Newcomen's engine. The first inventor to enter this field of development was Nicholas Joseph Cugnot, a French military engineer, who built a high-pressure traction engine in 1769. A few years later Oliver Evans, an American, invented a high-pressure steam engine which he used for various purposes. It is said that drawings of Evans' engine were sent to England and that Richard Trerithick used them in the construction of a road steam carriage and of the first locomotive to turn a wheel in Great Britain.

Young Firemen.

The fireman who imagines that he knows all about his business when he has learned how to keep up steam, "to keep her hot," as the saying is, labors under self deception. There are so many things to be learned about the proper management of a modern locomotive that years of study are needed to master the details. The first thing, of course, for a fireman to learn is the art of firing, and as soon as that is acquired he should be finding out everything about the mechanism of the engine and of its attachments. There are a great many officials in high positions in railway management, such as Mr. Willard, president of the Baltimore & Ohio, who began work as firemen and worked themselves upwards by learning everything there was to know about the business, and you, my fireman reader, has the same opportunity open to you if you will adopt the same policy that made them successful.

The same advice stands good with the young mechanics. It is a mistake to assume that a mechanic knows all that is necessary for him to attain, when he becomes skillful in the special kind of work he may have selected. There is a great deal of ignorance of first principles among careful and intelligent workmen where it ought not to exist. A man may have a thorough knowledge of running an iron planer, yet never become informed as to the design and details of constructing a planer and the advantages and disadvantages of peculiar features. The underlying principles of any business or occupation ought to be made a regular study by those engaged in it, so that the road may be open to them for improvement and progress.

We often find mechanics who have dropped down into a dead-set way of doing things and are positive in discrediting the value of any information that conflicts with their own fixed methods and ideals. In almost every instance of this kind the disinclination to give up old settled ideas for those more valuable may be traced to lack of elementary knowledge. Adhering to narrow fixed ways is not the policy that makes a mechanic more valuable than the average workman. The men who find out and practice the best methods of doing work are those who commend themselves for selection to higher positions. All workmen cannot be made general foremen or master mechanics, but it is certain that those who make themselves masters of their business have the best prospects of promotion.



CLIMBING A HILL ON THE SOUTHERN PACIFIC IN CALIFORNIA. SIX CONSOLIDATION LOCOMOTIVES MOVING 59 CARS.

Personnel of Railroad Commissioners.

Almost the only persons in the United States holding important positions without requiring to have education or training for the business are State Railway Commissioners. There are 82 men holding that position, 34 of them being lawyers. The others are composed of 10 farmers, 9 merchants, 7 railroad men, 6 politicians, 4 journalists, 3 civil engineers, 3 teachers, 2 carriage builders, 2 real estate agents, 1 banker, 1 carriage builder. Seven railroad men among 82 could be increased to advantage.

General Foremen's Department

Specialists.

He used to be the mechanical oracle of every community, great and small. He could patch up a machine that the machinist swore wasn't worth the rivets required in the patch. He could make a condemned boiler carry more steam than ever without a simmer. He could repair a watch, grind skates, put rivets into bladeless knives, make humming tops and botch up good work with a caution. He was attached to the machine shop and roundhouse about the same as a liveried fool was to courts of foolish kings. This is not the stone age, or the iron age, or the age of steel, nor yet the age of progress, it is the age of specialties. A few years ago and a printer must be a writer, proofreader, pressman and compositor, and now all the details of the business from blank paper to gilt-edged book—even to living on store orders. A machinist must be everything, from a watchmaker to a foundry man. A locomotive engineer must know how to build his engine, repair it, clean it, wash boiler, teach firemen, know the rules of the road and laws of the State concerning the same, and we had mightily poor engineers until locomotive running was recognized as an exclusive mechanical specialty. A few years ago, if a breakdown occurred in the shop, all hands sat down and waited for the jack of all trades to come to the rescue. Now they have men specially trained to look out for breakdowns. In all the works they have a man who has charge of the belting, and if a belt needs lacing he does it in his own room—for he keeps a duplicate of every belt in the place in reserve. If the main belt breaks there is not a hundred men idle while half a dozen men repair the belt, the "extra" takes its place and the other is repaired and itself goes on relief duty.

The writer was in a railroad repair shop recently when the division superintendent brought in a typewriter to be fixed, said it was out of kilter. The foreman looked at it, struck a key or two, and remarked: "I don't know much about these things." "Why," exclaimed the superintendent, "you have the reputation of being the best mechanic on the road; I thought you were just the man." The foreman turned to the speaker and said: "I am a locomotive repair machinist, and have carefully studied it for fifteen years; if you will bring me any job on a locomotive that I cannot do that any other can, I will resign; life is too short for a man to spread himself out so thin as to attempt to be familiar with all classes of machinery. There are men who make a specialty of typewriters, as I do of locomotives. They can repair that machine in half the time, for half the money, and twice as well as I can. I would be a fool to put new letters on that machine, as they would put a new tire on a locomotive. Let every mechanic have a specialty and stick to it."

Hard Riding and Noisy Engines.

As the purpose of a locomotive engine attached to a train is to take the train to the terminus on time, the engine should be so constructed that it will maintain the required speed with the least possible discomfort to the men who have to ride in the cab. Designers, as a rule, do their best to have engines built that will operate as smoothly and noiselessly as the nature of the machine will permit; but in a great many cases they fall very short of reaching perfection. Some engines ride so roughly that a man who first takes hold of them might be excused for thinking that some of the springs have been left off. The comfort and the health of the enginemen are seriously affected by the manner in which an engine rides. When a man spends eight or ten hours a day on an engine, making from one hundred to two hundred miles per day and does it six or seven times a week, he is certain to be well shaken up before a day of rest comes, no matter how smoothly the engine rides; but when the engine rumbles along like a country wagon on a rough road the fatigue of the enginemen is inordinately increased.

When an engine is in first class condition, properly proportioned and put together in a workman-like shape, the only noises heard in running are the impact of the wheels upon the rails and the sound of the exhaust steam. Beyond these sounds every noise is a discord; not to say that discords within this gamut are a novelty. Quite the reverse. The absence of foreign jars, rattles, pounds and screeches, represents an engine in perfect order, but that condition is not so common as it ought to be. Many engines that otherwise seem to be in good condition, rattle and pound through the peaceful fields like traveling flue cleaners, a state of things most trying to the nerves of the men who ride upon them.

Noisy engines are a nuisance, for the noise is caused by conditions that represent undue wear of parts. The constantly increasing weight added to locomotives does not appear to add to the smoothness of their operation or to make them ride more easily. Great weights are hard to carry and it is more difficult to provide easily resilient springs to resist heavy weights than to carry light ones with easy yielding action which may be the cause for many modern locomotives riding hard. An engine with the reciprocating parts badly counterbalanced rides roughly and so does one with the springs badly equalized. Of course stuck wedges or wedges that catch the box occasionally are enemies to smooth riding, as well as axle boxes that are too long for the pedestals. But perhaps the most common cause of rough riding is wheels with small flat spots, wheels getting out of round or one or more wheels worn smaller than the others.

These are a few of the defects that we have found productive of hard riding locomotives. If any of our readers have discovered other causes of this discomfort and will tell us about them, we shall gladly give particulars publicity for the good of the order.

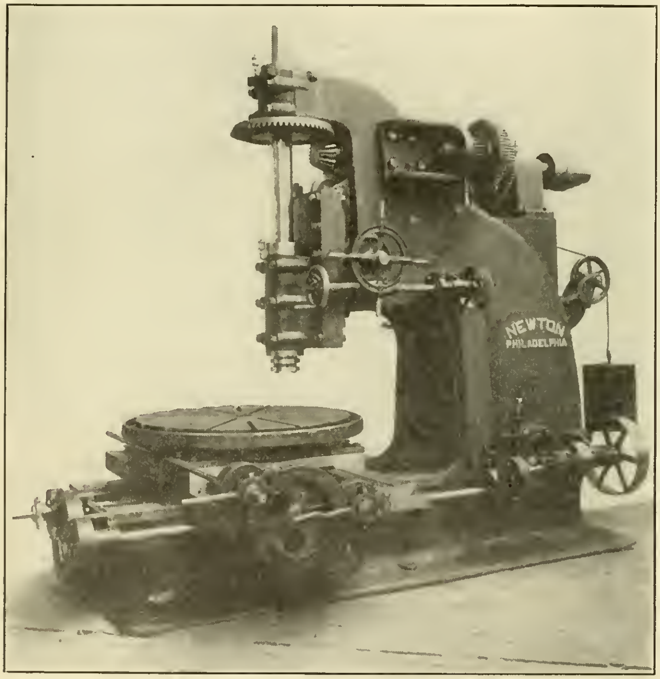
Injudicious Repairing.

Railroad companies have suffered from impaired incomes and increased expenses lately with the usual result that the mechanical department has been urged to keep down expenses to the lowest possible limit. History always repeats itself and we find that repairing worn-out rolling stock has been largely resorted to in cases where new locomotives and new cars should be purchased. That is done, of course, in the interest of economy and yet it is really very expensive. As hard times in ordinary domestic economy leads to the renovating and patching of old garments to defer the necessity for purchasing new ones, so it is natural for men in charge of railroad machinery to make repairs take the place of renewals at times when the earnings of their company are restricted. This propensity, while wise in its origin, is frequently carried beyond prudent limits and then it becomes expensive policy. Having the capacity for perceiving the point when it no longer pays to repair machinery, is a somewhat rare attribute; but there is no form of ability that pays railroad companies or machinery owners better. It is terribly

hard on some men to scrap an article that can possibly be used again. Every general foreman ought to train himself to preserve the habit of giving the scrap heap its just due.

It has come within the line of our experience to visit a great many railroad repair shops, good, bad and indifferent, and we have been forced to the conclusion that the inclination to repair worn-out parts is the most expensive practice found in railroad shops. Engine 387 gets a new set of axle boxes while two of the old ones are in pretty fair condition. These are laid away carefully under a vise bench to be handy should any other engine of the same class come in with a broken box. A discarded eccentric strap taken off 421 not more than 1/4 inch out of round is laid to repose in vicinity of the axle boxes and the adjacent space is occupied by an odd rod strap, several half-worn piston rings, or an air pump head, a nozzle top, a few brake heads a sand box cover, a few oil cellars and a mass of promiscuous litter considered too good for the scrap heap, where they eventually go after having been in the way for years, till the space they occupied overflowed. A shop run under the influence of this kind of sentiment is usually a museum of worn-out articles, every recess and corner being filled with material that long ago ought to have passed through the rejuvenating power of the cupola or forge. Good money has been paid for tons of pig and bar-iron whose place ought to have been taken by the scrap hidden away under the pretense of being available stock. Stuff of that kind is never available when wanted and its individuality is seen only at the annual resurrection caused by stock-taking.

A predilection for preserving half-worn articles is an inconvenient and expensive habit; but a fondness for keeping articles whose pattern has been changed is infinitely worse. In this case casting-house and store-rooms are littered with pieces kept on hand because they have not been used and never will be used. A vague hope is entertained that rough forgings and castings will come in handy for some purpose, but successive stock-takings come and go and obsolete articles appear to represent plenty of material, while real scarcity exists. When the pattern house is critically examined, what a charnel-house of obsolete practice it presents to the eye. Cylinder patterns that have not been off the shelf in a dozen years, oil boxes that this generation has not seen in use, eccentric straps that fit no engine in service, and hundreds of details whose use the old pattern house keeper cannot remember are preserved because they have not rotted out. These remarks contain a faithful description of a shop visited last summer.



NEWTON DIE SINKING MACHINE.

Die Sinking Machine.

The Newton Machine Tool Works, Philadelphia, Pa., have recently designed an exceptionally heavy die sinking machine. The accompanying illustration gives a good view of the massiveness of construction and fine proportion of parts. The dimensions of some of the parts are: Diameter of spindle, 5 ins.; length of spindle bearing, 22 ins.; distance center of spindle to upright, 38 ins.; maximum distance end of spindle to table, 22 ins.; minimum distance, 0 in. Length of spindle saddle traverse, 22 ins.; diameter of circular table over all, 48 ins.; diameter of circular table over oil pan, 54 ins.; length of cross feed, 48 ins.; length of in and out feed, 36 ins. Machine occupies a floor space of 14 ft. by 9 ft. 6 ins.

The foundation of this machine is one of the Heavy Vertical Milling Machines, redesigned, and provision made for conveniently adjusting all of the movable parts, reversing fast power traverse in addition to the power feed and adjustment.

The spindle saddle is counterweighted, has hand fast and hand slow vertical adjustment, in addition to reversing fast power traverse with four changes of belted feed, which is taken from the one transmission shown on the side of machine.

The feed and fast power transmitting shafts are clutched, the drive to the spindle is by means of a 10 horsepower motor which gives 9 to 18¾ r. p. m., driving through the back gears, and 49½ to 98 r. p. m. when driving direct.

The feeds per revolution of the spindle with the back gears in range from .069 in. to .243 in. and when driving direct with the back gears out .012 in. to .029 in.

The machine is an important addition to the excellent products of the Newton Machine Tool Works.

A Good Lubricant.

A good lubricant should possess the following characteristics: (1) Sufficient body to keep the surface from contact under the maximum pressure; (2) the least viscosity consistent with the requisite amount of body; (3) the lowest possible co-efficient of friction; (4) the largest capacity for receiving and carrying away heat; (5) a high temperature of decomposition; (6) it should vaporize at high temperature rather than decompose and burn on.

Occupation is one great source of enjoyment. No man properly employed was ever miserable.—*London.*

Questions Answered

VARIATION IN LEAD.

142. S. P. R., Rockford, Iowa, writes: In your February issue you describe the American Locomotive Company's engine, No. 50,000, and under the "setting," you give, "Lead ⅛ in. in full gear forward, ½ in. in full gear backward." My experience of four years in running a locomotive equipped with the Walschaerts valve gear has proved to me that the gear was constant at all times, the valve opening at the end of the piston stroke being always the same. How did they get ⅛ in. in forward and ½ in. in backward without changing the combination lever? A.—It is part of the constructor's design, and in the instance referred to is accomplished by the location of the return crank at some point other than at right angles to the main crank where it should be placed if the design is to have both forward and back openings of the valve equal and unvarying at all points of cut-off. The reason that such variations in the position of the crank, and the consequent amount of lead made in some recent locomotives, is owing to the fact that some eminent constructing engineers are of opinion that an increase in the amount of lead as the stroke of the valve is shortened is an advantage in locomotives running at high velocities. In the case of the Stephenson valve gear the increase in lead occurs as the valve stroke is shortened. In the Walschaerts gearing in order to bring about a variation in the amount of valve opening it is found in the case referred to that with ⅛ in. opening in full forward, and ½ in. in full backward, and which is caused by the offsetting of the return crank already referred to, as the reverse lever is "hooked up" and the valve stroke is diminished, the amount of lead is increased in the forward motion and diminished in the back motion, so that the amount of opening of the valve in the forward motion will have increased, the constructor's design being to equalize the amount of opening at the point where the locomotive may be said to do its greatest amount of work, and when moving at its higher speeds. It may be added that it would be an easy matter to so construct the gearing that the amount of valve opening could be constant at 5/16 in., but the ingenious engineers agree that this would be too much in full motion, and as the great bulk of the work done by a locomotive is while in the forward motion, the backward motion is thus purposely distorted to allow the forward motion to approach nearer to what is considered the ideal valve motion.

BY-PASS VALVES.

143. C. A. C., Columbia, Tenn., writes: Would you please give a description of the by-pass valve, and what are its uses? A. —The cylinder by-pass valves are two small cup-shaped valves mounted in chambers and bolted to the steam chest containing a piston valve, the larger face of the by-pass valve is in communication with the interior or steam chamber of the main piston valve, while the smaller face is on the side towards the cylinder. If by over-compression or other reason the pressure in the cylinder should increase to a dangerous degree, the by-pass valve acts as a relief valve, and opens communication between the cylinder and the steam chamber where the piston valve is located. When running with the throttle closed, the by-pass valves allow communication to be established between both ends of the cylinder, and the pressure upon the piston is equalized. The by-pass valves are not necessary on the ordinary sliding valve, as an extra pressure in the cylinder will lift the valve from its seat. In piston valves the extra pressure may break the rings. The by-pass valves are hardly liable to fracture, but should be occasionally examined as to their tightness when closed.

OVERFLOWING INJECTORS.

144. G. E. W., Grand Rapids, Mich., writes: Why is it that some injectors overflow while working, while others work without leaking at the overflow pipe? A.—Water leaking at the overflow valve simply shows that the overflow valve has not entirely closed. This is sometimes caused by clogged tubes, and sometimes by reason of the fact that the steam pressure is not sufficiently high, or the water may be too warm before entering the injector. Experience will soon teach an observing engineer that there are certain points of temperature and pressure essential to the proper working of an injector. The supply of water and steam must be so regulated as to produce the desired result. The newer kinds of injectors are much more likely to remain in good working order than the older types.

STEEL RAILS.

145. W. M. J., Rock Island, Ill., writes: To settle a dispute here please state when steel rails were first used in this country. A.—In 1867.

RUNNING BRAKE TEST.

146. A. H., Wheeling, W. Va., writes: How and when should a running test be made to determine whether all brakes are coupled up?—A. After leaving a terminal where the brakes have been tested an additional running test should be made before the train has proceeded 1,000 ft. provided that grade conditions will permit and if for any reason the test cannot be made within this distance without incurring the liability of stalling the train, it must be made at the first opportunity.

You are aware of the object of this test and will understand that the length of the brake pipe exhaust should be noted and whenever possible the test should be made with the engine and tender brake released.

With the E. T. brake this is done by holding the independent brake valve in release position while applying the train brakes.

WATER BRAKE.

147. G. P. Fitzgerald, Ga., writes: Will you please explain what is meant by a "water brake?" A.—A water brake is a steam locomotive brake operated by reversing the engine and admitting saturated steam to the cylinders. The brake is for use in descending heavy grades, the saturated steam being admitted by means of a special valve which is regulated according to the color or density of the steam issuing from the cylinder cocks. The retarding power is of course developed in the steam cylinders and transmitted through the connecting rods to the driving wheels.

POWER DEVELOPED BY LEVERAGE.

148. B. W. S., Princeton, Ind., writes: In a Westinghouse instruction book, a diagram of a foundation brake rigging is shown in which 3,000 lbs. in a brake cylinder is transmitted in 1,500 lbs. to each live truck lever, which are 5 to 1 levers. This gives a force of 7,500 lbs. developed by the lever, and if this force is transmitted to the force applied, point of a second lever of the same proportion, will it again multiply and develop a total force of 37,500 lbs. A.—Yes. The leverage arrangement you describe will develop the power that you have calculated upon, but you may have overlooked the distance of movement required to do work in the application of a leverage arrangement of this kind.

You assume the force derived from the use of a 5 to 1 lever to be transmitted to the force applied end of another 5 to 1 lever, and if we were to place a brake shoe at the final point of power developed and use a brake cylinder to develop the original force, 10 ins. piston travel at the cylinder would give 2 ins. movement at the force applied end of the second lever, and this 2-in. movement would result in 4, or about 13/32 of an inch movement at the final point of power developed, or in effect you have created a 25 to 1 leverage, and in order to move the brake shoe 1 in. the piston in the brake cylinder must travel 25 ins.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances.

Published Monthly by

ANGUS SINCLAIR CO.

114 Liberty Street, New York.

Telephone, 746 Rector.
Cable Address, "Locong," N. Y.
Glasgow, "Locoauto."

Business Department:

ANGUS SINCLAIR, D. E., Prest. and Treas.
JAMES KENNEDY, Vice-Prest.
HARRY A. KENNEY, Secy. and Gen. Mgr.

Editorial Department:

ANGUS SINCLAIR, D. E., Editor.
JAMES KENNEDY, Managing Editor.
ALLEN G. WOOD, Consulting Engineer.
GEO. W. KIEHM, Associate Editor.
A. J. MANSON, Associate Editor.

Western Representative:

J. A. CASSELL, 127 No. Dearborn St., Chicago, Ill.

Boston Representative:

S. I. CARPENTER, 643 Old South Building, Boston, Mass.

London Representative:

THE LOCOMOTIVE PUBLISHING CO., Ltd., 3 Amen Corner, Paternoster Row, London, E.C.

Glasgow Representative:

A. F. SINCLAIR, 15 Manor Road, Bellahouston, Glasgow.

SUBSCRIPTION PRICE

$2.00 *per year,* $1.00 *for six months, postage paid in the United States, Canada and Mexico. For other parts of the world,* $2.50, *or ten shillings. Single copies,* 20 *cents. Remit by Express Money Order, Draft, Post Office Order or Registered Letter.*

Mailing address can be changed as often as necessary—always give old and new address, and if you subscribe in a club, state the name of the agent.

Please give prompt notice when your paper fails to reach you regularly.

Entered at the Post Office, New York, as Second-class Mail Matter.

Inventing New Devices for Locomotives.

When any man attempts to improve any existing kind of machinery he should first make himself thoroughly acquainted with the machines in use as well as with every detail of their use. How few men do this who attempt to improve the locomotive. The devices that engineers are asked to try, that are entirely impracticable, are legion. Many an engineer has seen where he could improve on some part of an engine, but something, perhaps modesty, kept him back. No so with the genius who has got a new notion in his head about some change or other. He deliberately sets up posts and rode close to track to catch some hook he is going to put on engine that will turn some distant signal or ring a bell, or set the brake, regardless of how many heads it will take off besides. He puts a patent damper on engine that stands proudly up in the center of the deck and reminds the fireman that it is there at every turn. He puts a device on top of dome to save the steam wasted at the pop, and proposes to return its heat to boiler, and generally succeeds in getting everything else too hot to work —including the engineer. He gets out a new valve motion that does the work about as well as the link, and perhaps a little better; but at the cost of twice as many parts, cost and wear. He gets up a self-closing glass gauge cock that doesn't close. He invents a boiler compound that prevents scales from forming, and also soaks the form of steam so you can't drag it through the cylinders. He invents a 1,000-mile dope that will help the journals to melt in half that distance. He invents a side-shoot pilot that will throw a yearling bull over in a ten-acre field and not hurt him, but it throws a man into a wire fence. He invents a firebox and stack that keep cinders out of the car windows, and don't let the water in boiler get hot enough to shave with. He puts a snow flanger under the pilot that comes off and ditches the engine. He invents a steam bell ringer that will keep you from ringing the bell in the summer and freezes up and won't let you ring it in winter—or won't ring for you. And thus the improvers keep nagging away; once in a great while they hit it, but the rest of the time they hit something or somebody else. Many of the parts and appliances of locomotives are crude and unhandy, but the principles are all right and only want the details carefully considered and improved to make them all that can be hoped for.

Introduction of Standard Screw Threads.

In these days, when it is so much the fashion to discredit railroads and the benefits they have conferred upon the public, it is well to recall one act of a railroad company from which the whole industrial world of this continent is daily enjoying material benefits.

With the development of mechanical industries, much inconvenience began to be experienced by the middle of the last century, through the great diversity of screw threads used by different makers of machinery, and of apparatus involving the use of bolts and nuts Every machine shop owner and manufacturer had his own pattern, and there was studious care exercised to make threads different from those used by other makers. American mechanics have always been noted for their individuality, a quality that led them to abhor uniformity, even in screw threads.

The more far-sighted mechanics and engineers began gradually to appreciate the inconvenience resulting from diversity of screw threads, and William Sellers, one of the ablest mechanics this country has produced, in 1864 read a paper before the Franklin Institute of Philadelphia, in which he advocated the introduction of a system of screw threads which are now known as the U. S. Standard. Other systems of uniform screw threads had been proposed, but William Sellers was the first to devise a set of proportions and reduce them to formulae, so that the proper size, shape and pitch for a given diameter of screw can be determined without comparison with a pre-determined list. It also had the commanding merit, that it could be made with a common lathe tool made in the shop where used, a property that did very much to lead the way to its adoption in American workshops.

There is no doubt that William Sellers devised as perfect a system of screw threads as could be invented, but much more had to be done to give American industries the benefit of the great invention. There was no means of pushing the standard screw threads into popular use, and the small aid given by the United States Government was of a miserably blundering character. The United States navy adopted the Sellers screw threads, but the people who had charge of the mechanical details had so little conception of the value of such interchangeable parts that there arose a danger that there would be several sizes of the standards when the country was redeemed from this danger by the intelligence of a railroad engineer and the enterprise of the Erie Railroad Company.

No industrial interests were likely to obtain so much benefit from the use of standard screw threads as the railroad service, their cars were extending to every region of the country, and it was highly important that material for repairs should be of a uniform character throughout the entire railroad mileage. When the standard screw threads were devised there were no railroad mechanical associations in existence, so failing to find this powerful influence, Mr. Octave Chanute, chief engineer of the Erie Railroad, set himself resolutely to work to have the system introduced on railroads. His first move was to obtain the exact sizes of the United States standard threads as used in the navy. When he received gauges from the different yards he found that they did not agree. That was a disgraceful start for the United States navy mechanics to make, for when Mr. Chanute appealed to Mr. Sellers for the exact sizes of the threads it was found that none of the navy sizes was correct. Having found the proper sizes of screw threads, Mr. Chanute made

arrangements with the Pratt & Whitney Company to make gauges, and the Erie Railroad Company agreed to place an order for the gauges sufficiently large to encourage the tool makers to engage in their manufacture.

Through the influence of Mr. Chanute the mechanical department of the Erie Railroad adopted the standard screw threads, and all appliances used for cutting other threads were withdrawn from use. This proved an object lesson for other railroads that paved the way for the general adoption by railroad companies of the standard screw threads. The Master Car Builders' Association, which was formed at Altoona, Pa., in 1867, did not at first realize the importance of standard screw threads, but at the fourth convention the following resolution was presented: "What should be the standard number of threads to the inch of different-sized bolts, and what should be the thickness of nut in proportion to size of bolt?" This led to the appointment of a committee, which reported the following year in favor of the Sellers system of screw threads.

That action had a particularly strong influence in pushing standard screw threads into general use; but it should not be forgotten that the labors of Mr. Chanute prepared the way for the action of the Master Car Builders' Association.

Trespassers.

The foreign press is peculiarly given to pointing to the high death rate on American railways, and rarely or never take time to reflect on the causes that lead to the fatalities occurring on our railroads. When it is borne in mind that several of our largest railroads have more mileage than the entire railway systems of several European countries put together, it can be readily seen that the danger to trespassers is infinitely greater in America than in small, congested countries where the railroads are fenced with high walls and guarded with almost military precision. Such fencing and guarding of American railroads is something beyond our present-day possibilities, but almost everything is being done that can be done to awaken the public to the hazard of trespassing on railroads. A good illustration of this earnest work is shown in the returns made by the Pennsylvania Railroad Company. In 1907, there were 916 people killed while trespassing on the company's roads. The co-operation of city and county authorities was invited, and wide publicity was given to the efforts the company was making to put an end to this evil, which was annually costing so many people their lives. As a result of the efforts of its officers and employees, a reduction of 173, or more than 18 per cent. in the number of trespassers killed on the Pennsylvania Railroad in 1908 was effected. The railroad's activities in this direction were redoubled in 1909, and again was the death roll from trespassing reduced to 633, or about 15 per cent. There was a reduction of 36 per cent. in four years. The records for 1910 show that 585 deaths resulted from trespassing on Pennsylvania Railroad property.

Having succeeded in decreasing the practice of trespassing on its lines, the Pennsylvania system is now preparing to conduct an even more aggressive campaign during 1912. Tracks will be reposted with warning notices, the enactment of stringent laws will be requested, and every officer and employee of the system will be asked to lend his assistance to decrease still further the number of deaths resulting from trespassing on the property of the Pennsylvania Railroad system.

The renewed and diligent efforts the Pennsylvania Railroad is making to stop trespassing will be measurably influential, the management believes, in arousing the public to a realization that in accidents to trespassers it is the individual who loses his life, than which there can be no greater sacrifice.

Ferric Protector That Penetrates Metal.

Prof. Herman J. Lohmann's discovery of a method to permanently protect ferric articles from corrosion makes it possible to apply to the surface of steel or iron a coating of any non-corrodible metal of the lead group or a combination of these metals. The process is exactly similar, so far as the apparatus needed is concerned, to the present hot dip galvanizing process. The article to be treated is thoroughly cleansed either by a sandblast or in a pickle composed of sulphuric acid, etc., then washed and then placed in the so-called Lohmann bath, containing the chemicals used in his process. An immersion of from one-half minute to two minutes is all that is necessary and during that period the pores are thoroughly cleansed of oxygen and the amalgamating agent is deposited over the surface so that when it is dipped in the molten metal, the pores are filled and an integral union or chemical weld is made between the surface of the article treated and the non-corrodible coating.

In the present methods—and there is scarcely an exception, if any—the protective metal forms a surface adherence only with the steel or iron which it is supposed to protect and the pores still contain the oxygen, which eventually eats out or destroys the contact points with the protective metal, resulting in a gradual separation and the subsequent exposure of the steel or iron surfaces to the action of the atmosphere.

At present, also, the almost universal coating that is used is zinc, which as a metal is brittle and disintegrates very rapidly before certain conditions and, of course, is not resistant to sulphurous or sulphuric acid fumes and vapors. The fabrication of a zinc-coated article has to be done very carefully and even then minute cracks and pin-holes develop, which eventually result in the corrosion of the article it covers.

Under the Lohmann process, however, the filling of the pores and the integral attaching of the coating overcomes many of the objections and defects of a zinc coating and the Lohmann process can go so much further in the selection of a protective coating as to make it of the very greatest value to both the manufacturer and the consumer. By its use, lead, tin, zinc, aluminum and other members of the lead group, either singly or in combination, may be freely used and thus a coating to meet the requirements of the coated article may be furnished. In other words, where a steel article is to be exposed to a sulphurous condition, the well known resistance of lead to its action makes it possible to treat the article with a lead coating, and as a result of the large number of experiments during the past year, it is Prof. Lohmann's opinion that a coating composed of 100 parts of lead and 1 of tin will entirely supersede the present zinc-coated article. This lead-tin coating has proved of especial value in sheet work, as it is as pliable as a piece of paper and is resistant to practically every known element that attacks steel or iron. Another combination, composed of 10 lead, 10 zinc and 1 tin is used on various articles where extreme pliability is not needed and where a bright appearance is desired in the finished article. Of course, it is not as resistant to sulphurous fumes as straight lead, but resists to a very large degree these conditions.

The experiments that have been made in large manufacturing establishments, such as sheet mills, wire mills, etc., develop the fact that the use of the Lohmann process does not in any way reduce the output and, in fact, in most cases articles may be treated more rapidly than under the present hot dip galvanizing method, and there has never been a failure in securing penetration and integral union where the article has been passed through the Lohmann bath.

In so far as the operation of a Lohmann plant is concerned, the usual hot dip galvanizer will not know that he is pursuing any different course than in his old method. Therefore, no expert knowledge of chemistry is required to successfully Lohmannize articles.

The cost of the process depends almost entirely upon the character of the metals used. The lead-tin combination is cheaper than spelter and the 10, 10 and 1

runs about two cents a pound per pound of treated metal more than spelter under the present market prices. At the same time, a much thinner coating is secured, and it is quite possible that with the savings in dross, etc., the actual cost will be the same, if not a little less with all articles except sheets.

The usual test for galvanized material is the one minute dipping on what is known as the Preece Test, which is composed of sulphate of copper. This is not a true or proper test for Lohmannized material because the thickness of the coating is materially reduced under the Lohmann process and a much longer life given to the article because of the penetration and the union. At the same time, where lead and tin are introduced, they are more resistant to sulphate of copper than spelter. It has developed that there are two absolute tests only to be made. One is to etch the edge of the treated article and take a micro-photograph. This will always show the absence of a line of demarcation and will show the presence of the coating metal in the pores of the article, if there be any. In photographing a galvanized article, the line of demarcation is always plainly shown. Where it is possible, it is always well to cut a channel in a Lohmannized article, making cuts of say one-hundredth of an inch thick and having it analyzed by a chemist. He will develop the presence of the coating metal sometimes as deep as the fourth or fifth cut.

The value of this invention for the protection from corrosion of such articles as steel cars cannot be estimated. An entire car can be dipped in a tank designed for the purpose and it comes out impervious to rust and to all surface destructive agencies.

During the past 18 months the process has been given an exceedingly thorough test by the Erie Railroad, and so successful have they been that the Erie has erected a Lohmannizing plant at Jersey City and is treating a vast number of locomotive and car parts. Several sheet mills have secured licenses and the indications are that the process will soon be very extensively adopted.

No Hot Boxes.

At one period in the history of railways a constant source of delay to passenger trains was hot axle boxes. Twenty years ago one could seldom travel over a division without finding the train stopped while trainmen cooled down a hot box and supplied it with fresh packing. During the last year the writer rode nearly 20,000 miles in railroad trains and did not once experience delay from a hot axle box. The natural question arises, what has been the cause of this desirable change?

In the old hot-box days the people having charge of car operating did their best to run the cars with the least possible cost for lubricants, and inferior lubricants was the rule with no systematic inspection of car journals. Conditions became so serious that the more enterprising railroad companies decided that some radical cure must be effected, for with every increase in the weight of cars hot boxes increased in proportion. About that time the Galena Signal Oil Company began the practice of contracting to keep railroad car axles lubricated and the skillful management with expert knowledge which that company imparted to the business has practically ended the trouble from hot boxes.

Make Elementary Education Practical.

There has been considerable agitation in New York lately against the line of education imparted to pupils in the public schools. Those familiar with the subject insist that the trend of common school education aims at preparing the scholars for professional positions, and that it tends to unfit them for ordinary laboring occupations which most of them must follow. This is an old subject of complaint that prevails all over the world where schools are to be found, the schoolteacher being nearly always of uppish sympathies, forgetting that the great mass of any people must continue to be laborers, anciently called hewers of wood and drawers of water.

We think that the worst mistakes made in our common schools is the constant failure to give scholars instruction that will help them to make progress in the occupations by which they are destined to make their livelihood. Probably the school records of all our large manufacturing cities, and most of the smaller ones, will show on examination a preponderance of pupils whose parents belong to the mechanical class. Considering that the boys are likely to follow, when they grow old enough to select an occupation, the same line of business that their fathers have done, it is pertinent to inquire, whether they receive at school any instruction in the element of mechanical knowledge?

A little tuition in the first principles of mechanism, illustrated by simple experiments and accompanied by conversational lectures on the part of the teacher, is what should be insisted upon in every high school and grammar school in our country. The course of Natural Philosophy dwelt upon in the curriculum of most public schools, is nothing more than a dull routine of text book study, which instills in the pupils' minds scarcely anything of permanent value, but rather begets a distaste for mechanical research.

Without the aid of books an interest should be created in the elementary principles of mechanics, by a competent teacher, and a spirit of inquiry developed in the mind of the young learner. All of us know how lasting are youthful impressions and how easy it is to acquire in a short space of time, at an early age, tastes and inclinations that shape the future course of a busy life. Do parents sufficiently examine into the way their children are educated in the public schools? This is obligatory on their part. Skilled workmen should insist on having teachers employed who possess the ability to impart elementary mechanical information in a way to interest their children, and should further insist that some time be given to this important branch out of every school day. It would be no hindrance to other branches, but would rather be a help, for children's progress is generally measured by their interest in the school work. Let a good, correct foundation of elementary mechanical knowledge be laid, and the boy will go forward. United action on the part of practical artizans, who depend on the public schools to educate their children, will in almost any city, secure the kind of instruction we refer to. A little agitation of the subject will awaken a pride in the teachers themselves. It is time that children passed through the public schools should be able to describe a steam engine or explain the simple mechanical powers.

Weathering of Coal.

All coals suffer characteristic oxidation if continued for a sufficent time. The process of slow change which occurs at first can be divided into the following well-marked stages:

(a) The physical state of the coal is altered. Surface oxidation causes minute fissures, which rapidly extend right through the lumps; thus the size of the sound pieces continually decreases. (b) A change of weight occurs in three stages: (1) loss by loss of moisture and occluded methane; (2) gain by surface oxidation; (3) loss by escape of hydrocarbons formed by the partial decomposition of the coal. Stages 1 and 2 occupy more or less time, according to the exact state and nature of the coal, but spontaneous combustion rapidly follows on stage 3. (c) A loss of calorific power and a deterioration of lighting and cooking values follow the escape of gases from the coal. If the carbon content of the coal be low, and the atmospheric temperature high, this loss of gas is very rapid and may easily exceed 30 per cent. in one month's exposure. (d) The available by-products are diminished and the quality of the coke deteriorates. The quantity of ammonium salts recoverable may decrease 50 per cent. during three or four months. Coal stacked in the open air is bound to deteriorate, but the fire risk may be decreased by building only low banks. Storage under water is the best and safest procedure.—Electric Review.

Catechism of Railroad Operation

By Angus Sinclair

QUESTIONS AND ANSWERS.

Third Series Continued.

128. Should the engine you are running break a cylinder head how would you disconnect?

A. First take off the valve rod and close the steam ports with the valve secured on the middle of the seat. Would secure the valve by cramping the valve stem in the stuffing-box gland. Then would take down the main rod and block the cross head.

When a front cylinder head is broken, some people advise that the steam chest cover should be lifted and wooden packing inserted in the forward steam port which would obviate the necessity for disconnecting the engine.

129. What should be done in case a piston breaks?

A. Breakage of a piston nearly always involves breaking of the cylinder head. The same process should be followed as when the cylinder head is knocked out.

130. Should one of the cylinders get broken, what should be done?

A. In case of a broken cylinder the same action may be taken as in the case of a broken cylinder head. Then if it is desirable to operate the engine on one side the steam pipe joint in the smoke box should be loosened and a piece of sheet iron slipped into the joint. When the nuts are tightened steam will cease to pass into the cylinder on that side.

131. What should be done to prevent the entire disabling of the engine from a broken steam chest?

A. If steam chest is cracked down through one side only would wedge in between sides of chest and the bolts, holding cover down so as to close up the crack. In case that this could not be done successfully, would open the steam pipe joint in smoke box and close passage with piece of sheet iron.

132. Should the exhaust get out of square while the engine is working, what would it indicate?

A. That something is wrong with the valves or valve motion.

133. What would you judge was wrong in such a case?

A. A slipped eccentric, loose bolts in one of the eccentric straps, eccentric strap rod loose or broken valve yoke.

134. How would you locate the cause of trouble?

A. By examining the various bolts, inspecting each eccentric to see that it is in proper position on axle, then find out if anything is loose about rocker box valve rod and stem.

Should nothing wrong be found by this examination, would place the engine at half stroke on the right hand side, admit a little steam to the cylinders and move the reverse lever to forward and back motion, keeping the cylinder cocks open. If the steam changed from front to back in response to the valve movement, would conclude that side to be intact and would try the other side in the same way. If the trouble was caused by a valve stem broken inside of the steam chest or a broken valve yoke, reversing the engine would fail to cause steam to escape through the front cylinder cock on the side of the breakage. With inside admission valve, steam would blow from the front cylinder cock, not from the back one.

135. Why would you place the engine on half stroke on the side you wished to test?

A. Because the full movement of the valve can be secured when the crank pin is on the quarter.

Some engineers, in making that test of the valves, place the crank pin on the eighth when both sides can be tested without moving the engine.

136. After locating the breakage described, how should one proceed to put the engine in safe running order?

A. When a valve stem breaks inside the steam chest or a valve yoke breaks, the valve is always pushed to the front end of the steam chest. The first move then is to get the valve back upon the middle of the seat to cover the steam ports. If the engine has relief valve in front end of steam chest, disconnect valve rod; and after forcing valve to central position by pushing something through the relief valve opening, clamp stem to hold valve from moving back and block front end with a plug long enough to reach the valve through the relief valve opening, block the valve from moving forward, and proceed on one side. In such a case the cylinder head would be loosened sufficiently to admit the squirting of oil into the cylinder.

137. What would be necessary if the relief valve was on the back end of the steam chest.

A. In that case the back end of the main rod would have to be disconnected and cross-head blocked ahead. The disconnected valve rod and valve stem would hold the valve against the forward end of chest.

138. If a slide valve is broken, what can be done to run the engine on one side?

A. If it is a balanced valve and broken so that the steam ports cannot be properly covered, slip a heavy piece of sheet iron between valve and valve seat, and block valve front and back. The balance plates will then come down solid on valve and prevent leakage of steam to cylinder.

With the ordinary slide valve and common conditions, it may be the better plan to remove the valve entirely and block with hard wood, having the grain of the wood crosswise of the seat. With the sheet iron over the seat and steam chest filled with blocking so that the cover will close down firmly and make a steam-tight joint, proceed on one side without disturbing anything except the valve rod. Provision must be made to get oil inside the cylinder.

139. How would you proceed to block a cross-head securely?

A. By placing cross-head at one end of the stroke, and placing a block between end of cross-head and guide block to prevent it from moving. Would then secure the block to the guides by cord to prevent it from falling out.

140. Is it always necessary to so securely block the cross-head?

A. No. Where possible, the piston should be placed at one end of the cylinder and the valve placed at same end of the steam chest, so that the steam pressure will securely hold the piston in place.

141. Does it make any difference on which end the piston should be placed?

A. On engines having a driver back of the guides, the forward pin will sometimes strike the piston rod key, if the cross-head is blocked back. In this class of engines it should be blocked forward.

142. What usually ruptures steam chests and covers?

A. Excessive pressure caused by reversing engine when running fast. This makes air pumps of the pistons working in the cylinders, that fill steam chests, and dry pipes with compressed gases, finally causing rupture at the weakest point.

143. In case it is necessary to run an engine reversed, how can excessive pressure be prevented?

A. By opening the throttle valve. When this is done no pressure greater than that of the boiler can enter the steam chests and they are designed to carry that safely.

144. Suppose the engine you were running struck something that demolished cylinder and steam chest, how would you arrange to run on one side?

A. Take down main rod, take valve rod off the rocker and tie up the end. Open the smoke-box and insert a piece of sheet iron in the steam pipe joint as described in answer to question 131.

145. What should be done in the event of a link saddle pin breaking?

A. Put the reverse lever in a notch forward where the engine would be likely to start a train. Then raise the link on the disabled side to the same level as the good one and block between top of link block and link. Have another block ready of sufficient length to raise the link block enough should it be necessary to back the engine.

146. With one link blocked up, what must be guarded against?

A. Reversing the engine, unless the disabled side has been changed by raising or lowering to correspond with the good side.

147. How can it be known if an eccentric has slipped?

A. By a lame exhaust, or with a bad slip one of the exhausts disappearing entirely.

148. Having found out which eccentric had slipped, how should it be reset?

A. If it is a go-ahead eccentric, move the engine till the crosshead comes very near to the end of its travel ahead. Then move the eccentric around, pointing in the opposite direction to the back-up one leaning towards the crank pin or away from it, which would depend entirely on the style of valve motion, whether direct or indirect. As soon as steam appears at front cylinder cock, tighten set screws.

For back-up eccentric slipped, lever and crosshead will have to be placed in the opposite direction.

The proper way to avoid delay in setting slipped eccentrics is to have their proper positions marked while in the roundhouse. To do so place the engine on the forward center with the reverse lever in the forward notch. Then scribe a mark on crosshead and guide, doing the same with eccentrics and straps. If from any cause one eccentric slips and the engine is placed so that the crosshead and guide mark coincide, the marks on three of the eccentrics will correspond with those on the straps, while the fourth or slipped eccentric mark will be some distance away from the mark on the strap. All that is now necessary is to turn that slipped eccentric till its mark comes up to that on the strap.

149. What should be done in case an eccentric strap or rod breaks?

A. Take down the other strap and rod, cover ports and leave main rod to move.

150. How should an engine be disconnected if a lower rocker arm breaks?

A. Unless the link interferes, all that is necessary is to remove broken part of the arm, cover ports by placing valve in central position, leaving the main rod on.

151. What should be done in case a link block pin breaks?

A. With a broken link block pin there is danger of contact between link and rocker arm; so in taking the safe side take down eccentric straps and rods.

The Locomotive Fireman.

It is doubtful if there is a man on the railroad train who is less appreciated by the public than the fireman, and this little article is devoted to showing that he is a hard worked and unappreciated individual, says the *Pere Marquette Magazine.*

The public shakes hands with the conductor who has charge of the train, thanks the brakeman for many little courtesies, bows to the baggage master who looks after its luggage in transit, trusts its valuables with the express messenger, and talks long and loud of the "brave engineer." But the fireman—he who bends to his work and feeds the fire that makes the steam—is never mentioned.

Sometimes a purse is made up for the engineer. No one ever heard of the fireman getting a purse, but the records show that he has performed as many deeds of valor as the engineer. Again, if the train leaves the track or goes into another train, the fireman has fewer chances to escape than any man on the train, except perhaps the mail clerk, shut up like a rat in a cage.

When the fireman is at work, and that is nearly all the time when the wheels are turning, he stands stooped over, shoveling in the fuel, or raking the coals in the firebox; his view ahead is obstructed, and he cannot see the danger that may be dashing upon him.

The rattle and roar of the machinery may drown the engineer's warning call—a crash—the tender pins him to the boiler-head and he is dead. Standing in the narrow gangway, peering ahead, a sudden lurch around a curve may throw him off. Instances have been known when the coupling between the engine and the tank parted, and the fireman dropped between them to be ground to pieces. The records show that more firemen than engineers are killed in railroad wrecks.

About the only time the fireman has a little leisure is when the train is running down grade. Then "she is shut off," steam is saved, and the knight of the shovel climbs up to a cushioned seat and takes a breathing spell. Even then one eye is ahead, his hand on the bell-cord, and the other eye fastened on the steam gauge, whose little black hands, fluctuating back and forth, gauge his labor as well as the steam.

There is no science in "feeding" an engine that is not understood by one not in the business. There is a way to throw coal, and to empty the shovel and close the furnace door at the same time.

It requires nice calculation that tells how many "scoop-loads" are needed to send the hands on the gauge to the proper figure, deft handling to keep the deck of the cabin clean, and a hundred other little things that go to make a skillful fireman—one that saves money for the company by husbanding the coal.

In the old days the fireman on "wood-burners" had a hard time of it, and certainly earned the small money he received for his services; but he had a sinecure compared with the man in blue overalls and jumper who "stokes up" one of the huge "moguls" of the present day.

These engines haul freight and eat up coal as if it were greased paper. The fireman is at work continuously, and about the only time he has to rest is when his train "takes a siding" to let a more aristocratic passenger train pass.

Dropping Second Class Cars.

When railway operating was first introduced into the British Isles the managers attempted to provide traveling accommodations graded according to the social condition of the patrons and to be paid for accordingly. There were at first four classes. A few years' experience led to the relinquishing of the four classes, because too many people followed the habit of a noble lord who was asked why he persisted in riding third class, and answered because there is no cheaper class.

All the British railways held on to the classes, first, second and third, till about 1875, when the Midland Railway dropped the second class, but most of the other lines adhered to that refuge of poor gentility in spite of the frequent report that third was the only class that paid the expense of moving passenger trains. Now it is announced that several of the most important British railways, among them the London & North Western, the Lancashire & Yorkshire, and others are to abandon second-class accommodation. That may merely represent the growing democratic spirit of the British people, but if the matter was looked upon from a strictly business standpoint, we think the companies would reduce passenger train accommodation to one class.

Mr. James A. Scully, work superintendent for the Whiting Foundry & Equipment Company, of Harvey, Ill., and Mr. Geo. E. Jones, who has had charge of inspection, have resigned and organized the Scully, Jones & Co., of Chicago, engineering, manufacturing and supplies. The lines will consist of foundry equipment and supplies, machinists supplies and railway appliances.

Air Brake Department

Collecting Moisture.

Every railroad air brake man realizes the possible results of a frozen brake pipe on a moving train of cars and in order to keep ice from being frozen in the triple valves, distributing valves and brake pipes it is absolutely necessary to keep the moisture out of the pipes, which can only be done by eliminating water and high temperature air from yard test plants and by collecting in the main reservoir on the locomotive the water that is squeezed out of the compressed air and draining those reservoirs at frequent intervals.

If the temperature of the compressed air can be reduced to equal the temperature of the surrounding atmosphere before it leaves the main reservoir, all the moisture will be deposited at this point, but if the compressed air passes through the main reservoir at a high temperature the moisture will be deposited wherever the compressed air cools down to the normal temperature of the atmosphere.

Scientific men have been able to determine the composition of the atmosphere and measure the amount of moisture contained in each cubic foot and air brake men have discovered the manner in which this moisture can be collected and prevented from entering undesirable portions of the brake equipment.

In the first place, compressing free air or air at atmospheric pressure, consists of forcing together the fine particles of the atmosphere which results in friction and the friction generates heat, in fact the work done by the air pump or air compressor is converted into heat but in connection with the present subject it is not necessary to delve into the details which would involve the conservation and transformation of energy. The degree of heat generated during compression depends principally upon the pressure per square inch of the compressed air and the condition of the compressor and the temperature falls more rapidly when the compressed air is confined to or passing through long, slender reservoirs of the tube design, and the longer the discharge and equalizing pipes the more opportunity for cooling the air before leaving the reservoirs. However, there is a right and a wrong way of doing everything, and a proper length and installation of piping that will give the best results. Therefore, there is a possibility of going to extremes or of overdoing the piping arrangement.

The discharge pipe from the pump to the main reservoir should be from 25 to 30 feet in length and the equalizing pipe between the main reservoirs should be of the same length. The locations of piping and reservoirs will affect the results, but as a general proposition, any slight additional benefits derived from longer pipes at these points would be more than offset by the liability of freezing up in cold weather.

While we often find much shorter and sometimes much longer pipes and sometimes when two pumps are used, per locomotive, one will be found pumping into the same reservoir from which the brake valve is supplied and apparently no evil effect is in evidence, nevertheless those arrangements will not give the best results obtainable.

The proper method of connecting the pumps and main reservoirs when two pumps are used, is to have a separate discharge pipe of the proper length for each pump and to have both connected to the same end of the first main reservoir, the equalizing pipe to lead from the opposite end of the first reservoir to one end of the second reservoir, the brake valve receiving air from the opposite end of the equalizing pipe connection of the last main reservoir.

Objections to the use of one end of a reservoir for two separate pipe connections leaves a choice of an arrangement shown in the diagram of a system of piping which specifies a size larger pipe from the junction of the pump discharge pipes to the main reservoir.

This is a standard method of installation and with either practice it is desirable to make the equalizing pipe connection to the second main reservoir in a manner that will permit any water to drain back from the second reservoir into the first one.

If the reservoir location will permit this it will facilitate the draining of reservoirs and insure a freedom from moisture in the brake valve, location of piping and condition of compressors being satisfactory.

If an intermediate main reservoir is used the piping arrangement should, as in the first place, be installed in a manner that will compel a circulation of the compressed air through the entire length of every reservoir before it can reach the brake valve, but with three reservoirs a somewhat shorter equalizing pipe is permissible, and as a general rule of some advantage.

To understand just why the opportunity for collecting the moisture from the compressed air is enhanced by correct length of piping and proper circulation, it may be necessary, as well as interesting, to consider some of the simplest discoveries resulting from experiments conducted by scientists and air brakemen.

It has been demonstrated not only by scientists, but by the elements that the atmosphere can hold but a limited amount of moisture, per cubic foot, in suspension the amount depending upon the temperature of the atmosphere.

When the atmosphere is holding all the moisture it is capable of holding it is termed saturated. At 32 degs. temperature, 1 cu. ft. of free air or atmosphere, is capable of holding 2.37 grains of moisture or water in suspension which is, of course, in the form of vapor and at 52 degs. temperature 1 cu. ft. of atmosphere is capable of holding double the amount of aqueous vapor than it is at 32 degs., and it doubles its capacity to hold moisture with every increase of 20 degs. in temperature.

Thus it will be observed that while the temperature of the compressed air is high it readily holds the moisture in suspension, but is compelled to give it up, as its capacity is reduced by the lowering of its temperature, therefore the capacity of the atmosphere to hold moisture varies directly with the temperature and inversely with the pressure, that is, at any given pressure per square inch the higher the temperature the more water the compressed air is capable of holding then temperature remaining constant, the higher the pressure the less moisture the air is capable of holding.

This very clearly explains why and where the moisture will be deposited as in the act of compression the resulting temperature is generated so rapidly that the capacity of the compressed air to hold moisture increases more rapidly than the increase in pressure can reduce the capacity to hold moisture, hence there is no deposit of water in the air cylinder of the compressor, but as the temperature of the compressed air reduces and its capacity to hold moisture is reduced thereby, there can be but one result and that is the high pressure per square inch will squeeze the moisture out of the compressed air and deposit it at the point the reduction in temperature is taking place.

If the main reservoir location, capacity, and piping connections are approximately correct this cooling and deposit of moisture takes place in the main reservoir, provided of course that the compressor is not overheated, but with short discharge pipes, improper connections and overheated air pumps there is not only a

possibility but a probability of the temperature of the compressed air reducing after it reaches the brake pipe, which means an accumulation of water in the brake pipe with undesirable effect and a possibility of disastrous results in cold weather.

The Automatic Control Valve.

In describing the operation of the New York automatic control valve for locomotive brake equipments, the diagrammatic views of the valve in two different positions can be referred to.

In release and charging positions brake pipe pressure enters the valve at the point indicated "B. P." and is free to flow through the feed ports past the triple valve piston charging the auxiliary reservoir equal to the brake pipe pressure carried.

Main reservoir pressure is always present in chamber A, and atmospheric pressure in all other chambers as well as the brake cylinders if the automatic and straight air brake valves are in their proper positions for releasing the engine brake.

A reduction in brake pipe pressure affects the control valve triple piston in the same manner that any type of triple valve is affected, that is, auxiliary reservoir pressure forces the piston to a service position which admits auxiliary pressure to the control reservoir and chamber "D."

Pressure building up in chamber "D" moves the control piston and exhaust valve to close the brake cylinder exhaust and unseat the inner check valve and admit main reservoir pressure to the brake cylinders.

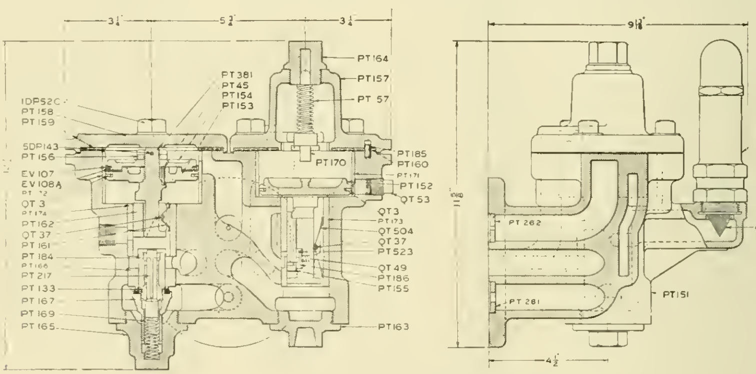
This will continue until brake cylinder pressure becomes a trifle higher than control reservoir pressure, when the control piston will move in the direction of the weakest pressure and allow a spring to close the admission or inner check valve.

When brake cylinder pressure falls a trifle through leakage, the control piston again moves to admit main reservoir pressure to the cylinders, thus maintaining brake cylinder pressure at a predetermined figure governed by the control reservoir pressure.

Control reservoir pressure, during automatic service operation, is limited to the volume and pressure of the auxiliary reservoir. The point of equalization is 50 lbs. from a 70-lb. brake pipe pressure.

The safety valve is connected through the graduating valve and slide valve, with the control reservoir when in service or emergency position, thus limiting brake cylinder pressure to the adjustment of the safety valve.

Service and emergency positions are practically the same, save, that larger openings secure a quicker response and in addition there is a flow from the automatic brake valve through the control reservoir pipe to the control reservoir, which maintains control reservoir pressure somewhat higher than in service by building up a trifle faster than it can pass off to the safety valve. This gives a difference between service and emergency brake cylinder pressures.



AUTOMATIC CONTROL VALVE.

The release may be accomplished at any time by moving the straight air valve to automatic release position, but the ordinary release occurs when the brake valve is moved to running position. The triple slide valve will be moved to its release position as soon as brake pipe pressure is increased or auxiliary pressure is lowered, but it cannot exhaust the control reservoir pressure through the retain pipe until the brake valve is in running position.

In release or holding position the brake valve acts as a turned-up retaining valve in addition to its usual functions.

As soon as the pressure starts to exhaust from the control reservoir and face of the control piston brake cylinder pressure forces it and the exhaust valve to their release position, exhausting brake cylinder pressure to the atmosphere.

While this brief explanation must serve for the time being a more thorough understanding of the operation of the equipment will be obtained from future issues when inspecting, testing, and methods of locating defects will be taken up.

Releasing Brakes.

These columns have from time to time contained references to the difficulties encountered in the operation of the air brake on long modern trains and to the fact that constant changes in conditions and equipments necessitate frequent changes in recommendations for successful handling of the brakes. It is not necessary to repeat that the time, place and amount of brake pipe reduction is almost exclusively governed by local conditions, but if all the factors entering into any individual case of train handling is submitted to the Westinghouse Air Brake Co.'s experts they can, by a series of demonstrations if necessary, outline a successful system of braking that will answer for the particular requirement.

If the service application feature of the brake is worthy of all the consideration it receives, and we believe it is deserving of more than it generally does receive, the correct methods to be employed in releasing brakes must also be of considerable importance.

From the safety appliance point of view the first consideration of the brake is the ability to apply it, the release being of secondary import, therefore the quick-action or emergency feature is paramount, but the correct release of brakes is now almost, if not, equal in consequence to the service application feature.

The reason for this is that the incorrect use of release position of the brake valve may produce just as disastrous a result as a wrong manipulation of the valve in service position.

There is no question but that improper manipulation of the brake valve can under certain condition produce dire results, as

a number of air brake men while making investigations along this line, were able to take certain make-up of trains and have no difficulty whatever in starting them with the locomotive and stopping them with the automatic brake, without causing any serious shocks, but during the experiments made for the purpose of ascertaining the effect of improper handling of the brake valve, it was developed that the train could be broken up and wrecked by the abuse of release as well as service position of the brake valve.

This possibility was recognized before the demonstrations and facts of this kind very strongly emphasize the necessity of keeping in touch with the latest developments in the air brake art, and in causes and conditions that lead up to them.

We do not believe in criticising the engineer who has had air brake trouble with modern trains under varying conditions of brake efficiency, and inefficiency, until a case of carelessness, disobedience, or lack of knowledge is clearly proven, and it is strictly up to an engineer to keep himself well posted in regard to conditions that air brake men are combating, so that he may be able to formulate an intelligent defence in the time of trouble and prevent, so far as possible, the shifting of every air brake responsibility upon the manner in which the brake valve is handled.

The primal object in keeping in touch with air brake progress should be to give intelligent and efficient service, and this will incidentally show that every air brake trouble does not begin and end with the engineer. If he is responsible he need have no fear that it will not be discovered.

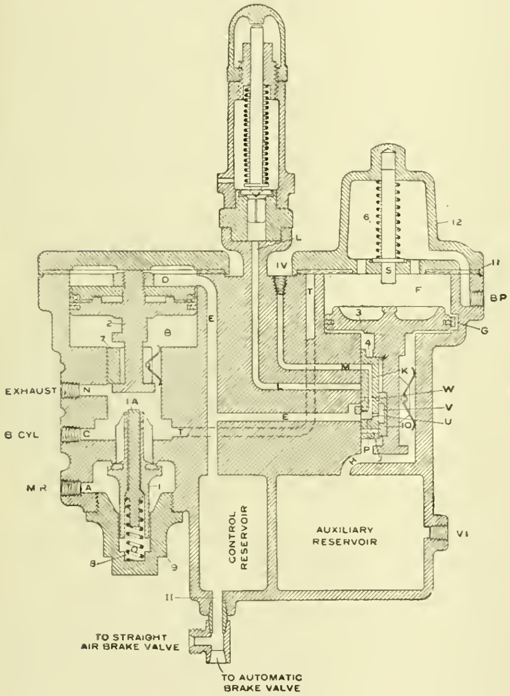
It would be gratifying if fixed rules regarding the use of release position of the brake valve could be made to cover all conditions of service, but this would be just as impossible as attempting to lay down a fixed set of instructions covering the use of service position, but we can point, for the benefit of our readers, to a number of general rules in reference to the use of release position of the brake valve, that are generally accepted as good practice.

Before any recommendations evolving from practical demonstrations are given, it may be well to state that the three governing factors in the use of release position are what can be termed time elements; they are, the time of the movement to release position, the time the brake valve remains in release position and the time that elapses between the movement to release position and the opening of the locomotive throttle.

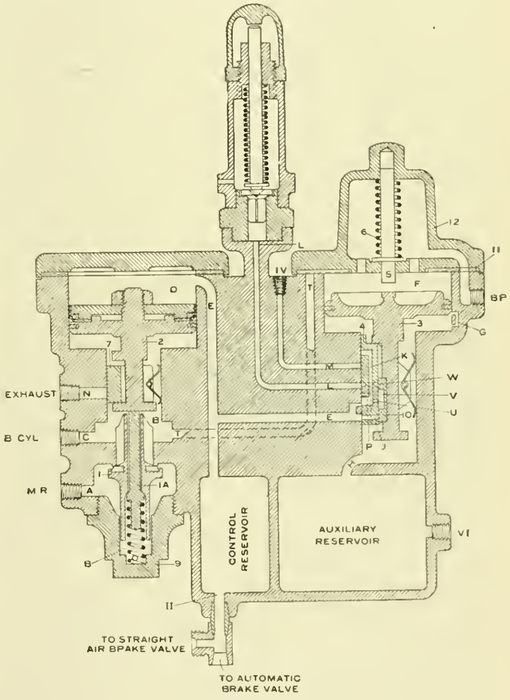
The time of movement to release position is governed by the speed of train, gradient of track and condition of track with respect to curvature.

The time the valve handle remains in release position under practically any condition of service depends upon the volume of compressed air in the main reservoir, the pressure per square inch and the capacity of the air compressors.

The time that elapses between the movement to release position and the opening of the throttle depends principally upon the volume in the brake pipe, the length of the pipe and the pressure per square inch in it. Of course main reservoir volume and pressure also enter into the latter time, but assuming a proper air pump and main reservoir capacity, the condition and length of the brake pipe is the chief consideration.



FULL RELEASE.



CHARGING POSITION.

Release position of the brake valve is for releasing the train brakes and charging an empty brake pipe, but the time of placing the handle in release position is not at a time when a long freight train is moving at a slow speed.

There are, of course, exceptions or modifications for any given recommendation and if a freight train of ordinary length contains a sufficient number of type K triple valves on the head end to hold the slack in, and provided that the engine is equipped with an independent or straight air brake, the train brakes can be released at low speeds, otherwise the train should be allowed to come to a stop.

A poor time and place to use release position is when track conditions and equipment of train will allow the head brakes to release and start away from cars with partially or still fully applied brakes on the rear end.

An example would be a release with H triple valves at a time when the head end of a train was descending a grade while the rear portion was ascending.

Another time for the use of release position is when its use for keeping the train brakes off is necessary.

Of equal consequence is the time the valve handle is allowed to remain in release position during an ordinary release of brakes.

With a 9½-in. pump recharging 60 or 70 cars, it is not of so much consequence, but with the air pump and main reservoir capacities found on modern locomotives, this length of time must be carefully noted during each release.

On descending a grade of considerable length a constant use of release position between applications is necessary for a prompt recharge and re-application and an overcharge of the head brakes is essential to a prompt recharge of the rear brakes. When running position is to be used this high overcharge on the head end is to be prevented by returning the valve handle to running position in from 5 to 10 seconds after moving to release position.

If type K triple valves are used, it will require about 15 seconds in release position to force the valves to retarded release position and of course the high overcharge of the head brakes is prevented by the uniform recharge feature of the triple valves.

The reason that 5 to 10 seconds' time in release is sufficient for H valves is because the rise in brake pipe pressure is so slow, due to pipe friction and the driving head required to maintain the flow of compressed air, that 25 or 30 cars back in the train, a gauge will show that the rise in pressure is so near alike in both cases that it cannot be told whether the brake valve is in release or running position, therefore, the continued or somewhat longer time in release will only give a trifle faster rise in pressure, but will at the same time result in the very undesirable high overcharge of the brake pipe and auxiliaries on the head end.

It will be understood that this time in release has reference to proper air pump and main reservoir capacity and it will occur to the reader that the 9½ or the 11-inch pump with a 40,000 cubic inch reservoir will not seriously overcharge any portion of an 80 or 100 car train in a time that is considered in seconds.

Having stated that the time elapsing between the movement to release and the opening of the engine throttle should be governed principally by the length of, and pressure in, the brake pipe, it is also assumed that pump and main reservoir capacity are sufficient; then under the most favorable conditions of releasing brakes on 80 and 100 car trains, at least 1 or 1½ minutes should be allowed, in fact, must be allowed if the train is not to be started with some of the rear brakes partially applied. By the most favorable conditions we mean when the brake pipe reduction or leakage has not lowered the pressure beyond the point of equalization of car brake pressures.

If for any reason brake pipe pressure has fallen lower, the time between the movement to release position and the opening of the throttle must be extended accordingly.

A general rule worth bearing in mind is, that minutes instead of seconds in time must be considered under such conditions.

Apropos of this time element, it might be of interest to cite a commendable brake valve manipulation in every day practice.

The writer recently had occasion to ride into a terminal point on a freight locomotive equipped with two large air pumps and ample main reservoir volume, the locomotive hauling 90 cars and upon approaching the yard, at a very slow speed, a signal to stop was given by the switchman.

The engineer stopped the train with a full service reduction and no shock worthy of mention was experienced, but about the time the train stopped a signal to proceed was given, and with the train at rest the brake valve was placed in release position for about 12 seconds and then returned to running position for about 30 seconds, whereupon the switchman began a frantic system of signals to proceed, emphasizing them with some very uncomplimentary language, but the engineer was apparently indifferent to his appeals and with a secondary movement to release position, "kicked off" the head brakes that had re-applied from the slight overcharge, and after a further wait of about 5 seconds' duration, opened the engine throttle and pulled the train into the yard without a slip of the driving wheels.

While this method of release may not have been theoretically correct in every detail, it does indicate that the engineer in question recognized a time element in the releasing of brakes. The writer has also witnessed a number of cases of freight train handling that conclusively proves that the time element is not always regarded. At a certain point along a road where long freight trains frequently stop to set off or pick up cars, it is not a very unusual occurrence for the engine to remain cut off from the train long enough for practically all of the brake pipe pressure to leak away, and many times an engine with a 9½-in. or 11-in. air pump and a main reservoir capacity of 40,000 or 45,000 cubic inches, was coupled to a train that had been at rest for 10 or 15 minutes with the brakes applied, and as soon as the hose were connected, the brake valve handle would be placed in release position and the engine throttle opened almost the same instant.

The object was, of course, to get the train into motion as quickly as possible, but in nearly every instance noted, the train could not be started within from 2 to 4 minutes and this time would be spent in throwing the reverse bar backward and forward to take in slack, and in some instances in bleeding off brakes, and not infrequently were attempts made to move the train while the engine and tender brake were still applied.

After a lapse of sufficient time to accomplish a release of all the brakes, these trains were started without any difficulty and it is evident to the air brake man that taking up slack and dropping sand on the rail can in no wise hasten the release of brakes, but the misdirected efforts to move the train with some of the brakes applied, merely presented the opportunity for breaking the train, in fact, in a case of this kind the engineer does all in his power to part the train and if he does not succeed it is because the draft gear is too efficient for the tractive effort of the locomotive to part it.

Electric Welding.

The discussion of electric welding in railroad repair shops, before the New York Railroad Club last month called out a big attendance. The author of the paper, Mr. O. S. Beyer, Jr., is in the mechanical department of the Erie. While a novelty in the railroad shop, he said, electric welding has during the past few years been employed in many branches of manufacturing. In this work the arc type has been found best adapted for shop repairs.

"It appears as if the day were not far distant when electric welding will be standard practice," said the speaker, "instead of repeated caulking of flues, firebox seams, and mudring seams, we will weld them once and maintain them welded.

"The system is simple in both installation and operation. One of the most important advantages is the extreme localization of the heat. This avoids the formation of large heated formations of metal adjacent to the place where the weld is being made. Consequently, when the work cools, no strains are set up, to cause buckling. This feature has made possible the welding of flue bridges and complete sets of flues without trouble."

A scriber made from hard brass wire gives a fine light yellow mark on black metal surfaces, such as stove-pipe material, boiler plate, and the like.

Electrical Department

Construction of a Modern Railway Motor.

In the description of the railway motor we have considered the two general types of frames, namely, the "box" and "split" types, and have described the mechanical construction of the commutator and armature. After the commutator has been pressed on the spider and the armature shaft pressed into place, the whole is hung in a lathe ready for the armature winding.

ARMATURE WINDING.

The winding consists of coils of wire or copper strap which have been, previously, wound on a form so that the size and shape will be such that the coil will slip into the slots in the core without much forcing, thus preventing damage being done to the insulation. An armature coil is shown by Fig. 10. This coil is known as a "two turn" strap wound coil and each turn is made up of five separate copper straps or conductors which are insulated from each other usually by a flexible mica tape, the whole five being covered by tape, and the two turns afterwards held securely together by more tape as is clearly seen by referring to the Fig. 10. After taping, the coil is placed in a hot oven, heated up in a vacuum and impregnated with an insulating varnish or compound which penetrates through the tape and fills all spaces, thus preventing moisture from entering and damaging the coil, and serves also as a good insulation. This compound or varnish hardens after the coil is removed from the oven.

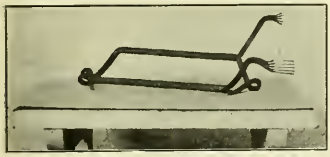


FIG. 10. ARMATURE COIL.

Armature coils are also wound of insulated copper wire, but the strap-wound coils have many advantages. The Westinghouse Electric Manufacturing Company use these strap-wound coils on their modern motors, and this is one of the principal improvements which make the operation of their motors so successful. The advantages will be obvious: about 10 per cent. more copper can be placed in the same slot than with wire-wound coils, which means that more current can flow through the coils, and hence more horsepower from the motor. This increase of copper is due to the fact that rectangular shaped wire adjusts itself to the rectangular shape of the slot and no space is lost. The heat generated by the flow of current through the copper wire can thus radiate easier to the core, and moreover, less compound or insulating varnish is required to fill the spaces. This compound is not a good conductor of heat, so that with wire-wound coils where considerable compound would exist the heat is not conducted away as readily and the temperature of the motor windings will be higher.

The strap-wound coil also facilitates the winding of the armature and damage to the coils is less likely to occur, as the surfaces in contact with each other are flat surfaces and the pressure is distributed over a greater area than with the wire coils. In the latter the wires tend to cut the insulation as there is only line contact. In winding the armature it is sometimes necessary to pound the coil into place, and the advantage of the strap coil is clearly seen.

Before placing the coils in the slots the rear-end bell and the front core casting are covered with tape and strips of treated cloth to protect the coils. Referring to Fig. 10 it will be noted that the coil will not lie in two adjacent slots but with three or four intermediate slots between the two sides. This width of coil depends on the size and design of the motor.

The core slot is deep enough to take two coils. Commencing with the first coil, which we will call coil A, one side is placed at the bottom of slot No. 1, and the other side will go in, say, the top half of slot No. 5; coil B will go in bottom of slot No. 2 and top of No. 6; coil C in bottom of slot No. 3 at top of No. 7; coil D in bottom of slot No. 4 and top of slot No. 8; Coil E in bottom of slot No. 5 and top of No. 9, and so on around the armature. After coil E is put in place the other side of coil A, which we said goes in the top half of slot No. 5, can be put in place. Thus when the armature is completely wound each slot contains 20 conductors. Each conductor is now placed in the saw cuts in the commutator bars and the armature is ready for banding.

ARMATURE BANDING.

The banding of an armature consists in placing steel wires around the core and over the coils so that they will not fly out of the slots due to the centrifugal force of rotation. Fig. 11 shows an armature complete and ready to be placed in the motor housing. To protect the coils and to keep dust from the windings asbestos cloth hoods (H) are placed over the coils on the commutator and pinion ends and are held in place by the steel wire bands (B), which also hold the coils in place outside of the core slots. These bands are put in under several pounds pressure. Narrow bands (C) are placed at intervals along the core and are known as "core bands." At intervals of every few inches strips of tin (T) are placed under the steel wires with the ends bent over to keep the wires together. To maintain the tension and to add mechanical strength the band is soldered its whole length.

To give proper contact for the passage of the electric current between the commutator and the conductors placed in the saw cuts in the commutator bars, the armature is set upright in a special piece of apparatus and hot solder is brought up around the commutator and kept there for several minutes until tinned and good soldered connections are made. This method is satisfactory for small and medium size armatures, but in large armatures it is usually necessary to hand-solder the conductors into the commutator bars to insure a good job.

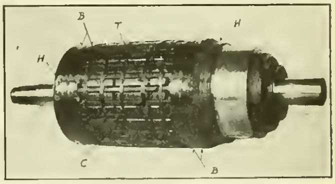


FIG. 11. THE ARMATURE.

THE BRUSH HOLDER.

One of the most important parts of the railway motor is the brush-holder. Fig. 12 shows two views of the type used by the Westinghouse Electric & Manufacturing Company on their railway motors. As the name implies this part of the motor is to carry the brush (T) which is in contact with the commutator and through which the current flows into and out of the armature coils. The brushes are blocks of carbon ⅝ in. to ¾ in. wide which fit the holder (A) snugly but not tightly as

one of the specifications are that these brushes can move up and down vertically but that they shall not be loose in the holder.

The brush plays a very important part and can cause much trouble and damage to the motor. Excessive wear of the commutator, sparking, etc., may be caused by the use of an improper brush. As stated the brushes are made of carbon but there are all grades, hard and soft, with different processes of manufacture and different motors operating under different conditions will require different grades of brushes for the best operation.

These brush holders must be exactly located so as to bring the brushes to exactly the neutral points where no sparking will exist. To secure this, the clamps which hold the brush-holders are located by template. At the same time these holders must be insulated from the clamps and this is done as follows: Referring to Fig. 12 the main casting (A) is fitted with two rods about ⅜ in. to ½ in. diameter, over which are placed mica tubes. To protect this insulation a thin brass tube (D) is placed over the mica. Just previous to assembling the brass tubes the corrugated porcelain insulators (E) are put in place and the whole sealed by an insulating compound. The corrugated insulators are to increase the creepage distance from the holder, which has the full voltage, to the brass sleeves which is ground. With this method of clamping the whole holder can be moved up and down and proper clearance obtained between the commutator and the face (F).

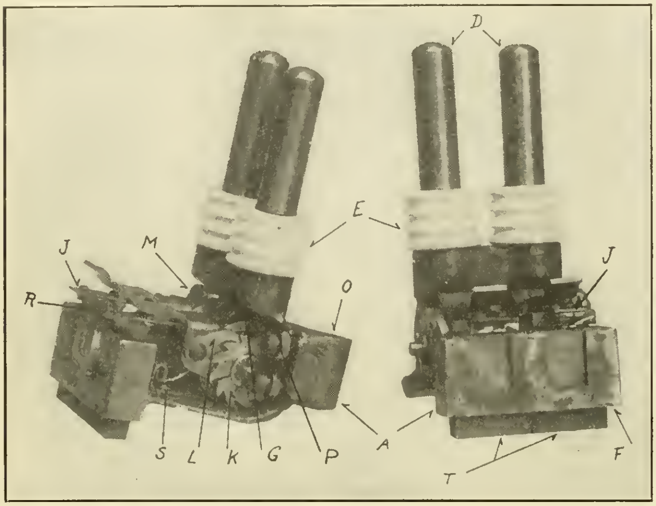


FIG. 12. THE BRUSH HOLDER.

To get proper contact between the brushes and the commutator it is necessary to maintain a pressure on the brushes. This is accomplished by the spiral clock spring (G) made of phosphor bronze, which transmits its power to the brush through the hammer (J). Different pressures are required for different conditions and the spring tension can be adjusted by the ratchet (K) and pawl (L). To prevent heating of the spring, and thus loss of tension, a copper braid, called a shunt (M) is provided which conducts the current around the spring or shunts it, one end of this shunt is fastened to the hammer by the rivets (R) and the other to the main holder by rivets (S). The wire which carries the current to the holder is held in the hole (O) by the screws (P). Two of these brush holders are used for all railway motors except those of large sizes. These holders are placed where they are easy to inspect and where the brushes can be replaced easily.

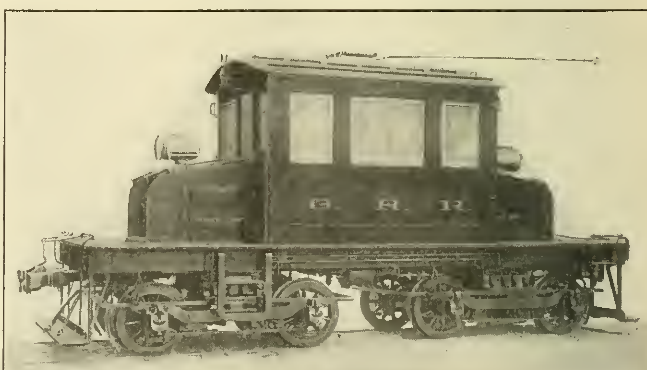
27-Ton Locomotive for the Guelph Radial Railway Co.

The Guelph Radial Railway, Guelph, Ontario, has recently purchased a 27-ton Baldwin-Westinghouse direct-current locomotive. The cab, trucks and all mechanical parts were built by the Baldwin Locomotive Works, and the electrical equipment was furnished by the Canadian Westinghouse Co., Limited, of Hamilton, Ontario, after the design of the Westinghouse Electric & Manufacturing Company, of East Pittsburgh, Pa.

This locomotive is compactly built and may be used for freight and switching service. Interurban and city railways are using locomotives like this one and larger for various kinds of service, for a road's earning capacity can be materially increased by using locomotives to haul freight during the night or idle hours.

The locomotive is ruggedly built. The frame is of channel iron construction, and the cab is substantially built of clear ash fitted together with joint bolts and corner plates.

The electrical equipment consists of four 40 h. p. motors, and the locomotive is capable of handling on the level 17 cars, each weighing 45 tons at 10.75 miles per hour. The principal dimensions are: Length over end sills, 23 ft.; width over all, 8 ft.; truck centers, 12 ft.; rigid wheel base, 6 ft.; total wheel base, 18 ft.; wheel diameter, 33 ins.



THE GUELPH RADIAL RAILWAY LOCOMOTIVE.

The man who holds down the ladder at the bottom is frequently of just as much service as the man at the top.

Mikado Type of Locomotive for the Chesapeake & Ohio

Considerable interest has been awakened by the introduction in the motive power of the Chesapeake & Ohio Railway of a new Mikado type of locomotive built by the American Locomotive Company, and shown in the accompanying illustration, and which is designed to haul 4,000 tons on a 3 per cent. grade at a sustained speed of 15 miles per hour.

It has a tractive power of 60,800 pounds, which is unusually large for an eight-coupled road engine, and some 3,000 pounds more than that of any locomotive of the same type yet constructed. This points to widespread possibilities in the Mikado type as a design for heavy road service on lines of moderate grades.

Aside from the fact that it is the most powerful engine of its type yet constructed, the design presents another still more interesting feature. A very complete interchangeability of parts has been obtained between this locomotive, designed for heavy moderate speed freight service, and the Mountain type locomotives of the Chesapeake & Ohio, constructed by the same builders for a most difficult passenger service in which they are now running. The Mountain type provides a larger boiler capacity than the Mikado; and as far as the service possibilities are concerned, this is the real difference between the two. This is due, primarily, to the fact that with the two-wheel leading truck of the Mikado, in place of the four-wheel truck of the Mountain type wheel arrangement, and the resulting shorter total engine wheel base of the former, its boiler must necessarily be shorter than that of the latter, though the two designs may be the same in other respects.

Nevertheless, the design here illustrated is practically a conversion of the Mountain type into a Mikado by the substitution of a two-wheel for the four-wheel leading truck of the former with but few other changes, and those of such a character that there is duplication between the two classes of almost all the parts that require relatively the most frequent renewals or need to be kept in stock.

A study of the illustration and principal dimensions of the Mikado here presented, discloses the ingenuity of the builders in preparing the design in consultation with the motive power officials of the road to secure the duplication of parts between it and the Mountain type, together with the highest efficiency for the service for which it is intended.

Outside of the differences in the wheel arrangement a reconstruction of the boiler was necessary, but like the Mountain type, the Mikado is equipped with a brick arch supported on water tubes. The difference in the slope of the throat sheet, however, made a slightly different arrangement from that applied to the Mountain type necessary. A mechanical stoker of the same type as that with which the previous engines were equipped has also been applied. The various changes in the design have reduced the weight 15,000 pounds, the engine here illustrated having a total weight of 315,000 pounds, as compared with 330,000 pounds of the Mountain type. It is probable that this engine will be used in service similar to that in which the Mallet locomotives of the Chesapeake & Ohio are now operating. This will give opportunity for interesting comparison, and will attach especial interest to the performance of the Mikado, which should be carefully followed.

This adds another modern up-to-date class of motive power to those which have been very successfully introduced on the Chesapeake & Ohio, during the past two years, of the progressive attitude of Mr. J. F. Walsh, the general superintendent of motive power of the road, towards present-day transportation problems is well known.

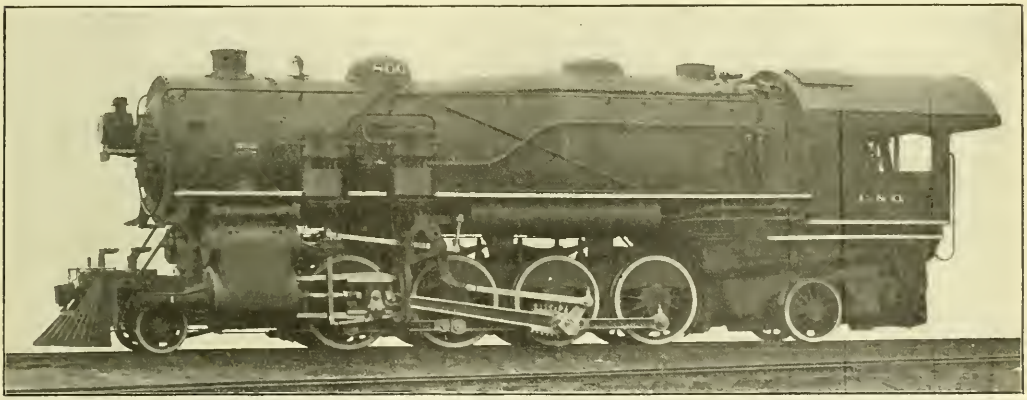
The following are some of the principal dimensions:

Cylinder.—Type, simple piston valve; diameter, 29 ins.; stroke, 28 ins.

Wheel.—Base, driving; 16 ft. 6 ins. rigid; 16 ft. 6 ins.; total, 34 ft. 9 ins.; wheel base, total, engine and tender, 67 ft 11 ins.

Weight.—In working order, 315,000 lbs.; on drivers, 243,000 lbs.; estimated working order engine and tender, 484,700.

Heating surface.—Tubes, 5½, 1,090 sq. ft.; 2¼, 2,650 sq. ft.; total, 4,051.2 sq. ft. S. H. surface, 845 sq. ft.



2-8-2 TYPE OF LOCOMOTIVE FOR THE CHESAPEAKE AND OHIO RAILWAY.
J. F. Walsh, Gen. Supt. of Motive Power. American Locomotive Company, Builders.

Grate.—Area, 66 ft. 7 ins.

Axles.—Driving journals, main 11½ ins. x 14 ins.; others, 10½ ins. x 14 ins.; engine truck journals, diameter, 6½ ins.; length, 12 ins.; trailing truck journals, diameter, 9 ins.; length, 14 ins.; tender truck journals, diameter, 5½ ins.; length, 10 ins.

Boiler.—Type, conical connection; O. D. first ring, 83¾ ins.; working pressure, 170 lbs.; fuel, soft coal.

Firebox.—Type, wide; length, 114⅛ ins.; width, 84¼ ins.; thickness of crown, ⅜ in.; tube, ½ in.; sides, ⅜ in.; back, ⅜ in.; water space, front, 5 ins.; sides, 4½ ins.; back, 4½ ins.

Crown staying.—Radial; tubes, 238; diameter, 2¼ ins.; length, 19 ft.; gauge, No. 11 B. W. G.

Boxes.—Driving, main and others cast steel.

Engine truck.—Two-wheel radial center bearing.

Trailing truck.—Radial with inside journals.

Exhaust pipe.—Single; nozzles, 7⅜ ins., 7⅝ ins., 7⅞ ins.

Piston rod.—Diameter, 4½ ins.; piston packing, Hunt Spiller rings.

Smokestack.—Diameter, 18 ins.; top above rail, 14 ft. 10 ins.

Tender.—Frame, 13 ins. steel channels.

Tank.—Capacity 9,000 gallons; fuel, 15 tons.

Valves.—Type, piston, travel, 7 ins.; steam lap, 1 3/16 ins.; expansion lap clearance, ⅛ in.

Setting.—3/16 in. lead.

Wheels.—Driving diameter, outside tire, 56 ins.; centers diameter, 50 ins.; material, main and others cast steel; engine truck, diameter, 30 ins.; trailing truck diameter, 42 ins.; tender truck diameter, 33 ins.

Forty flues, 5½ ins. diameter, 19 ft. long, No. 9 B. W. G. Charcoal Iron.

Engine equipped with fire tube type of superheater.

Brake Applications in Case of Break-in-Two.

A well-known master mechanic of a northwestern railroad writes us as follows:

Several enginemen and trainmen have made the statement that with the largest types of air pumps on freight locomotives, when the train breaks in two the pumps will keep the brakes from setting, or if they do set the pump capacity will release them on the section of the train with the engine, without closing the angle cock. An article from your magazine may enlighten some who believe that a large capacity air pump is an excuse for losing half of a train along the road.

In an effort to comply with this request we will mention the results of an interesting road test that was conducted about a year ago on the Big Four Railroad, where, with an 8½ in. cross compound compressor on the locomotive and with the automatic brake valve handle in running position, it was found impossible to move the front end of eight, ten and twenty car trains when the angle cock on the rear end was opened. By placing the brake valve handle in release position and releasing the brake on the locomotive with the independent brake valve, it was possible to keep the train moving with the angle cock wide open on the rear of a twenty-car train, but as soon as the automatic brake valve handle was returned to running position the brake would apply on the locomotive and the train would be brought to a stop.

This demonstration is cited as an example to illustrate that it is quite possible for trains to break in two in service and the forward portion of the train continue in motion under certain combinations of conditions. With the brake valve handle in full release position there is no positive assurance that the brakes on the front end will apply sufficiently to bring the train to a stop or call the engineer's attention to what has happened.

The E. T. equipment, however, offers more effective protection than would otherwise exist, in that with the brake valve handle in full release position it is impossible for the driver brakes to release after they are once applied, so that the engineer would have to have both automatic and independent brake valve handles in full release position in order to keep moving, which would certainly be an unusual manipulation.

From the foregoing it is clear that with the brake valve in running position the feed valve controls the brake pipe pressure and if an air hose is uncoupled quick action will, under ordinary circumstances, occur on both sections of the parted train regardless as to the number or capacity of the compressors on the locomotive.

If the train parts while the brake valve is in release position, brake pipe pressure will be exhausted from the front portion of the train and the brake applied as soon as the valve handle is returned to running position, thus if the front end of a parted train runs a considerable distance away from the rear end it is due either to incorrect manipulation of the brake valve or to a very serious condition of brake inefficiency, as we know of but two cases in which a swinging air hose closed the escape of air from itself.

Release position of the automatic brake valve is for releasing train brakes and if the engineer runs over the road with the brake valve in release position because brake pipe leakage is in excess of the capacity of the feed valve, he must expect to be held responsible for the results. If he will be guided by the following standard instructions he is not likely to lose any portion of an air-braked train.

Never allow the brake valve handle to remain in lap position except when it is desired to hold the brakes applied and it should not then be allowed to remain in this position a sufficient length of time to permit brake cylinder leakage to materially diminish the braking power.

After an emergency application of the brakes while running over the road, due to any cause other than intended by the operating engineer himself—

(1) In passenger service move the brake valve handle to emergency position at once and leave it there until the train stops.

(2) In freight service move the brake valve handle to lap position and let it remain there until the train stops.

If such a stop is made on a grade, after the train stops the handle should be moved to emergency position and left there to insure the brakes remaining applied until released by the engineer in charge of the train or until hand brakes can be set to hold the train, if a stop for any length of time is required.

WHEN NOT IN USE, CARRY THE HANDLES OF BOTH BRAKE VALVES IN RUNNING POSITION.

Cottonseed Oil.

Dr. H. W. Wiley, chief of the bureau of chemistry in the Department of Agriculture, has been investigating cottonseed oil with results that will be gratifying to the cotton sections at least. He declares that cottonseed oil is the most wholesome, palatable and nutritious cooking, salad and table oil, and that no other oil known "begins to hold the rank that cottonseed oil does, nor has it the future that this oil has." It is claimed that the winter pressed oil is better that either olive or peanut oil for dressing salads, because it is more easily digested and will not ferment in the stomach. Every year large cargoes of this oil are exported to Europe, where after it is put through a refining process by the French and Italian dealers it goes into the channels of trade as olive oil. It is predicted that cottonseed oil will eventually drive olive oil out of the market, and in that event it will be of immense material advantage to the South. As a substitute for butter and lard in the kitchen it is now being used in immense quantities, for wherever it has been tried its superiority over the best cow butter in the making of cake has been demonstrated.

Thinkers and Workers.

It is no less a mistake to despise labor when regulated by intellect, than to value it for its own sake. Some people these days are always trying to separate the two; they want one man to be always thinking and constitute that his special business, and another to be always working. One they delight in calling a gentleman, the other an operative; whereas the workman ought very often to be a thinker and the thinker ought to be working, while both should be gentlemen in the best sense. When the practice exists of giving the thinker more honor than the worker, both are put into false positions, the one envying, the other despising his brother, and the mass of society is made up of morbid thinkers and miserable workers. It is only by labor that thought can be made happy; and the professors should be liberal, and there should be less pride felt in peculiarity of employment and more in excellence of achievement. Pride of achievement is the most admirable sentiment, is the greatest stimulant to happiness to be found among men.

New Coaches for the Erie.

It is interesting to note that among the other leading railroads the Erie is making extensive additions to its car equipment with a view to meet the growing traffic, especially in what may be called the suburban traffic, which has been greatly increased since the opening of the new additions to the road between New York and Middletown and other congested districts. Fig. 1 shows a general outline of the new design of their 60 ft. coach, adapted for suburban traffic, and of which design large orders are already issued and still larger are in contemplation. The principal dimensions of this type of passenger coaches are: Length over end sills, 60 ft.; width over side sills, 9 ft. 8 in.; center to center of bolsters, 45 ft. 6 in.; distance between center sills, 12⅞ in.; distance between draft sills, 12⅞ in.; kind of truck, 4 wheel steel; size of journals, 5 in. by 9 in.

The side sills are of yellow pine reinforced at ends by ½ in., by 7½ in. steel plate sills. The end sills are composed of two pieces of white oak, each piece 3⅝ in. by 8 in., to be reinforced by steel plates ¾ in. by 7¾ in. The rafters, carlines and letter boards are of best quality of white wood 1¾ in. thick. The outside sheathing are of the best quality of yellow poplar ¾ in. thick by 2½ in. wide.

Both ends of the cars are equipped with Pullman wide vestibules without side doors or traps, and finished with Ajax diaphragms and hoods. The entire design and finish is elegant and substantial.

Fig. 2 shows an outline of the combined 61 ft. passenger and baggage car, which possesses the same general features as the passenger car with the addition of a freight compartment. This style of car has proved itself to be admirably adapted to suburban traffic, the handling of light freight being done with a degree of facility and expedition that meets the requirements of the service with a degree of satisfaction worthy of a wider degree of imitation. Among the firms who have supplied and are still supplying large quantities of material for these elegant and serviceable cars may be mentioned the names of McConway & Torley Co., draft gear and other equipment, the Standard Coupler Co. buffer arrangement and other attachments, the Pullman Company's lighting appliances, the Westinghouse Air Brake Company and New York Air Brake Company, the Chicago Railway Equipment Company, the Pittsburg Spring and Steel Company's springs, and B. F. Goodrich Company's air brake hose and other equipment.

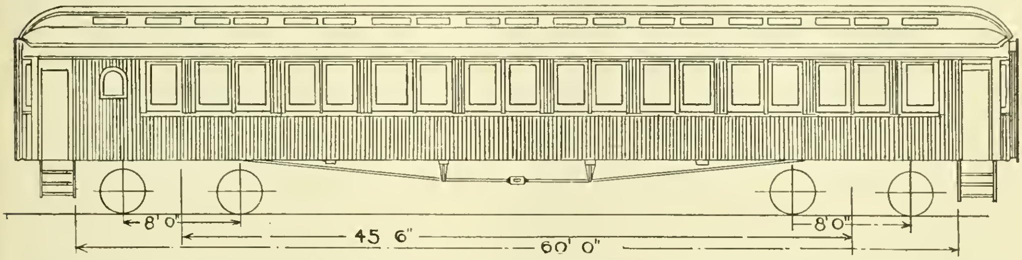


FIG. 1. OUTLINE OF NEW DESIGN OF COACHES FOR SUBURBAN TRAFFIC ON THE ERIE.

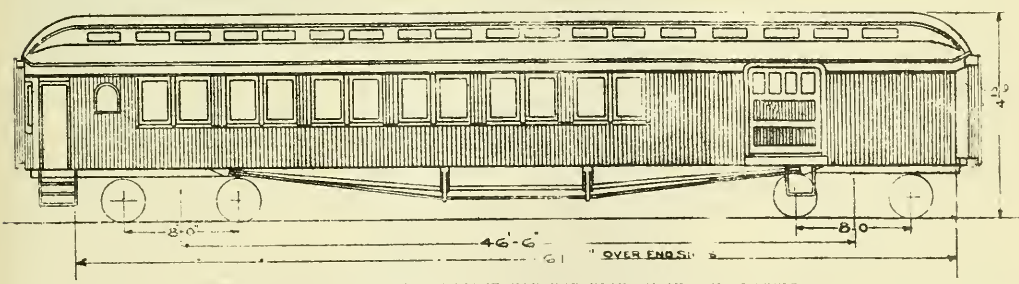


FIG. 2. COMBINED PASSENGER AND BAGGAGE CAR FOR ERIE SUBURBAN TRAFFIC.

Safest Portion of a Car.

Every winter when train accidents are more common than in summer, we hear the question frequently repeated, which is the safest part of a car and which portion is most comfortable? There is no preferable part of a car for safety when a train has jumped the track and is tumbling over an embankment; but in cases of collision there is less damage done to the middle than to the ends of a car. For many years the writer was in the habit of collecting particulars of fatal train accidents, and the facts seemed to prove that about five people were killed in the six seats at each end to one in the middle seats.

The middle seats of a car are preferable to the end ones for another reason, viz., that there is less vertical movement in the middle than at the ends. There is no yield to car sills and framing; yet every old traveler avoids the seats, and especially the sleeping berths seats, above the trucks, and old travelers generally know what they are doing. The movement of a railway car resembles in a modified degree the movement of a ship which is greatest at the extremities and least amidships. The trucks that carry a car are located towards each end. When inequalities of the track give up and down motion to the truck that movement is imparted to the car. The point above the truck receives the concussions direct and is forced upward, causing a jar on settling down. This jar is scarcely felt at the other end of the car and is not of more than half the intensity in the middle of the car. The consequence is, that the seats towards the middle of a car are on the neutral point where the jerks transmitted from the trucks are reduced to a comfortable limit. This is why riding in the middle of a car is not only safer than at the ends but more comfortable as well. It need hardly be added that we cannot all sit in the middle of the car, but if there is room that is the place to sit.

Items of Personal Interest

Mr. E. H. Beard has been appointed master mechanic of the Arkansas & Gulf at Laark, La.

Mr. James Keenan has been appointed roundhouse foreman of the Wabash at Lafayette, Ind.

Mr. W. A. Reddie has been appointed road foreman of engines of the Vandalia at Indianapolis, Ind.

Mr. John Bunten has been appointed machine shop foreman of the Santa Fe at La Junta, Colo.

Mr. G. A. Hillman has been appointed machine shop foreman of the Erie shops at Port Jervis, N. Y.

Mr. H. Wanamaker has been appointed superintendent of the New York Central shops at Depew, N. Y.

Mr. D. O'Leary has been appointed master mechanic of the Columbia & Puget Sound, at Seattle, Wash.

Mr. S. C. Kennedy succeeds Mr. J. F. Donellan as locomotive foreman of the Great Western at Clarion, Ia.

Mr. Eugene F. Callaher has been appointed general foreman of the Santa Fe shops at San Bernardino, Cal.

Mr. J. C. Bensen has been appointed master mechanic of the Great Northern with office at Grand Fork, N. D.

Mr. I. M. Webster has been appointed roundhouse foreman of the Trinity and Brazos Valley at Teague, Tex.

Mr. R. I. Higgins has been appointed general roundhouse foreman of the Baltimore and Ohio at Glenwood, Pa.

Mr. L. H. Raymond has been appointed superintendent of the New York Central's locomotive shops at West Albany, N. Y.

Mr. A. T. Shortt has been appointed master mechanic of the Alberta division of the Canadian Pacific, succeeding Mr. R. A. Pyne.

Mr. P. C. Linck has been appointed general foreman of the Chicago & Eastern Illinois, at Danville, Ill., succeeding Mr. W. D. Smith.

Mr. O. W. Hitt has been appointed general foreman of the Detroit, Toledo & Ironton, at Jackson, Ohio, succeeding Mr. T. J. Price.

Mr. Fred M. Baumgardener has been appointed train master of the Springfield division of the Illinois Central, with headquarters at Clinton, Ill.

Mr. D. J. Muller has been appointed master mechanic of the western division of the Cleveland, Cincinnati Chicago, and St. Louis at Mattoon, Ill.

Mr. F. D. Fosdick has been appointed road foreman of engines on the West Iowa division of the Chicago and North Western, with office at Boone, Iowa.

Mr. R. C. Hutten has been appointed general foreman of the Erie shops at Jersey City, succeeding Mr. G. H. Norton, who has been transferred to Hornell, N. Y.

Mr. C. E. Boss, formerly master mechanic of the Frisco Lines at Sherman, Tex., has been appointed master mechanic of the Texas and Pacific at Big Springs, Tex.

Mr. G. E. Sisco, assistant master mechanic of the Pennsylvania Lines, has been appointed assistant engineer of motive power, with offices at Columbus, Ohio.

VETERANS OF THE PORT JERVIS SHOPS, ERIE RAILROAD.

Mr. W. F. Harris has been appointed general foreman of the Baltimore & Ohio Southwestern at Cincinnati, Ohio, succeeding Mr. W. H. Keller, transferred to Flora, Ill.

Mr. W. H. Snyder has been appointed assistant general foreman of the Erie shops at Stroudsburg, Pa., in place of Mr. F. S. Davey, promoted to master mechanic at the same place.

Mr. A. Ross has been appointed superintendent of the New Jersey and Lehigh division of the Lehigh Valley, in place of Mr. G. M. Harleman, who has been assigned to other duties.

Mr. I. W. Senger, supervisor of materials in the locomotive and car department of the Lake Shore at Cleveland, Ohio, has been appointed master mechanic at Englewood, Ill.

Mr. C. K. Shelby has been appointed master mechanic of the Pennsylvania at Olean, N. Y., and Mr. W. J. Rusling succeeds Mr Shelby as master mechanic of the Northern Central at Elmira, N. Y.

Mr. P. F. Smith, Jr., master mechanic of the Pennsylvania Lines at Columbus, Ohio, has been appointed superintendent of motive power of the new division known as the Central System, with offices at Columbus.

Mr. J. F. Sheahan, who was recently appointed master mechanic of the Georgia & Florida, at Douglas, Ga., has been advanced to the position of assistant superintendent, with offices at Douglas, Ga.

Mr. F. H. Hansen, formerly foreman of the Lake Shore & Michigan Southern, at Collinwood, Ohio, has been appointed supervisor of materials in the locomotive and car departments of the same road.

Mr. C. W. Irvin, tool foreman of the Santa Fe at Cleburne, Tex., has been appointed roundhouse foreman at Cleburne, in place of Mr. Thomas Moore, appointed foreman of the Santa Fe shops at Sweetwater, Tex.

Mr. Manny J. Nash, chief train dispatcher of the Texas and Pacific at Texarkana, has been appointed trainmaster of the transcontinental division, with headquarters at Texarkana. He is succeeded by Mr. L. V. Ellison.

Mr. A. W. Sullivan, formerly general manager of the St. Louis, Iron Mountain & Southern, has been elected chairman of the American Railway Association Committee on Railway Mail Pay, with headquarters in New York.

Mr. H. F. Wardell, superintendent of power and equipment of the Chicago &

Western Indiana and the Belt Railway of Chicago, with office at Chicago, has resigned to become assistant manager of the Central Locomotive and Car Works.

Last month the Westinghouse Air Brake and Traction Brake Company removed the office of their southeastern manager, Mr. E. A. Craig, from the general office, Wilmerding, Pa., to 308 Westinghouse building, Pittsburgh, Pa.

Mr. F. M. Nellis, secretary of the Air Brake Association, announces that the annual meeting of the association will be held in Richmond, Va., May 7-10. The attendance promises to be unusually large. A full report of the proceedings will be published in RAILWAY AND LOCOMOTIVE ENGINEERING.

Mr. E. P. Roberts, president of the Cleveland Engineering Society, has been appointed smoke inspector of that city by Mayor Baker. Mr. Roberts is an excellent authority in the causes and prevention of smoke, and good results are expected when the new bureau is established.

Mr. Howard Gould has resigned as director of the Denver & Rio Grande, and has been succeeded by Mr. E. L. Brown, the newly elected vice-president. Mr. F. J. Shepperd, formerly of the Northern Pacific, and later of the Santa Fe, has been appointed assistant to President Bush on the Denver & Rio Grande.

Mr. F. L. Nicholson, chief engineer, and Mr. D. W. Lum, consulting engineer, with offices at Norfolk, Va., and Mr. J. E. Gould, superintendent of motive power, with office at Berkeley, Va., of the Norfolk Southern, have been appointed to similar positions on a new line in North Carolina—the Raleigh, Charlotte & Southern.

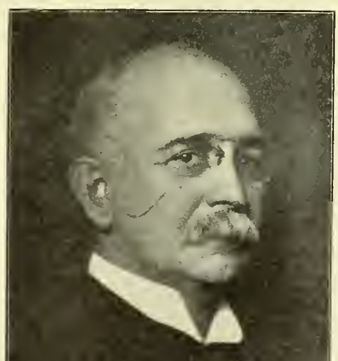
Mr. Frank F. Coggin, who for several years represented the Chicago Car Heating Company in New England territory and who for the past six months has been in the employ of the Ward Equipment Company, has returned to his former position with the Chicago Car Heating Company, headquarters at 170 Broadway, New York City.

Mr. J. T. Carroll, formerly superintendent of motive power of the Baltimore & Ohio at Pittsburgh, Pa., has been appointed assistant general superintendent of motive power, with offices at Baltimore, Md., and Mr. E. J. Searles, has been appointed to succeed Mr. Carroll at Pittsburgh. Mr. Carroll is a graduate of Purdue University and is a railroad man of wide experience and marked ability.

Mr. Peter Drummond, for the last fifteen years locomotive superintendent of the Highland Railway of Scotland, has accepted the same position with the Glasgow South Western Railway. On the occasion of his leaving Inverness the chief officers of the Highland Railway entertained Mr. Drummond at a banquet which many distinguished railway men attended. Mr. Peter Drummond is a brother of Mr. D. Drummond, chief mechanical engineer of the London & South Western Railway.

Among recent changes in the staff of Manning, Maxwell and Moore, Inc., Mr. L. H. Mesker has been appointed manager of the St. Louis branch, with offices in the Frisco building. Mr. Mesker succeeds Mr. C. L. Lyle. Mr. Frank P. Smith renews his connection with the company and will be associated with the railroad department. Mr. C. R. McCullough, formerly with the Packard Motor Car Company, has also become associated with the Manning, Maxwell and Moore Company, with headquarters at Detroit, Mich.

Mr. L. A. Darling, formerly of the R. G. Peters Manufacturing Company, Grand Rapids, Mich., has affiliated with the Remy Electric Company, Anderson, Ind., as Engineer of the Locomotive Headlight Department. Mr. Darling has long been connected with the engineering profession. At one time he was steam turbine designer for the General Electric Company, Lynn, Mass., and later assistant professor of machine design, Cornell University, afterward becoming chief engineer of the R. G. Peters plant.



FRANCIS H. STILLMAN.

Obituary.

Francis H. Stillman.

Mr. Francis H. Stillman, president of the Watson-Stillman Co., for many years a prominent figure in machine tool and engineering industries, died on February 18, at Brooklyn, N. Y. Mr. Stillman was in his sixty-second year, being born in New York City in 1850. He was a graduate of Yale University. He was particularly prominent in social as well as manufacturing associations, aside from his continuous activities in various engineering organizations and projects. Mr. Stillman was one of the recognized pioneers and perhaps the most prominent American engineer on hydraulic machine tool construction. On leaving college Mr. Stillman first associated himself with the Cottrell Printing Press Company, then with his step-father, Mr. Lyons. In 1883 he organized and become president of the firm of Watson & Stillman, which succeeded Lyons & Co. The firm was incorporated in 1904 as the Watson-Stillman Company, Mr. Stillman remaining its president up to the time of his death. Under Mr. Stillman's direction, his firm early became prominent in the hydraulic engineering field, has built upwards of 4,000 different types and sizes of hydraulic machines and has now a large and active plant in Aldene, N. J.

Mr. Stillman's affable disposition, high standard of business integrity and kind personal interest in all those with whom he came into contact, won for him a large circle of friends who will keenly regret their loss in his death.

W. F. Buck.

Mr. W. F. Buck, superintendent of motive power of the Atchison, Topeka & Santa Fe, with offices at Chicago, died on January 31 last. Mr. Buck began railway service as a machinist on the Northern Pacific Railway, and was rapidly promoted to shop foreman, general foreman, and master mechanic. In 1904 he was master mechanic on the Santa Fe at Needles, Cal. He was advanced to the position of mechanical superintendent in April, 1906, and finally to superintendent of motive power in January, 1908. He was a typical Western railway man, and in addition to his acquired mechanical ability he was active and earnest. He was attacked with tonsilitis, and died while being removed from a hospital at Albuquerque to Los Angeles. His death is much regretted.

James R. Dunbar.

Much regret is expressed at the death of Mr. James R. Dunbar, general freight and passenger agent of the New York, Ontario and Western. Mr. Dunbar had been in poor health for some time. He entered the company's service in 1890, after having been identified with the passenger department of the Wabash for a number of years. After acting for a few years as general eastern passenger agent of the Ontario and Western, he was, in 1894, promoted to the position he held when he died. He was in his fifty-first year. He was universally esteemed by all who had the honor of his acquaintance.

Railroad Character Sketches

By JAMES KENNEDY

SHAW IS CIVIL SERVICEABLY EXAMINED.

When a public announcement was made that a Civil Service examination was to be held for the positions of State Inspectors of Locomotive Boilers, Shaw got busy. Of course, he was not aware that the members of the Legislature, who were promoting the measure had already promised to distribute the prospective places among their constituents twice over. Some things that we do not know of may hurt us, but it is often better that we go heroically on our way. Macfarlane and Billy and the foreman boilermaker, who would make a good candidate for the Old Mechanics' Home list, helped Shaw in the way that a deserving man should be helped in an earnest effort in a good cause.

When the examination day came, Shaw was there with "bells on." His courage stuck out in solid chunks. The examination room was full of bewildered bookkeepers, male and female, trained nurses in frills and feathers, also bespectacled statisticians, with job lots of clerks, and an assortment of apothecaries' assistants thrown in, who also trailed on.

The would-be boiler inspectors had a corner to themselves. Shaw had time to size up his fellow strugglers in the contest. Nearly all of them bore marks of facial contact with flying rivets. One veteran carried a flattened rivet, that had knocked his left eye out, as a watch charm. Hands, hard and hooked, like eagle's claws, showed a greater familiarity with riveting hammers than with pen or pencil.

In spite of the clamor of questioning and commanding going on in the four or five other intellectual contests, some of the boiler inspecting brigade could be heard sighing heavily, as if charged with soda water, their suppressed breathings quivering like the fitful starts of a half-opened safety valve, and anon exploding into vehemence like the passionate exhaust of an overworked freight engine. Shaw had his troubles. What kind of electric current may be most successfully used by villainous workmen in order to deceive ignorant or careless inspectors? This set Shaw guessing. Was the current to be used upon the boiler or upon the inspectors? The question did not state. He recalled the fact that he had heard that alternating currents were used in some States for the purpose of shocking certain kinds of criminals to death, so Shaw risked that kind of current. To the question of how far the use of tap bolts should be used in closing a crack, Shaw neatly replied that they should be used as far as possible. To the question of how could the exact height of the water in the boiler be discovered when it was below the lowest gauge cock, Shaw replied that it could be found by removing the dome cap and inserting a dry stick.

These poorly worded questions, and lame and evasive answers were not comforting to Shaw, and his troubles were heightened by a loud-voiced examiner telling a particular division to spell "sieve," and "sibyl," and "subtilty," while another general of division, who loved to hear the echo of his own voice, was vociferously stating that any one who desired to eat anything, now was the time to produce the home-made pie or the store-made cup custard, but they should bear in mind that the time occupied in consuming these doubtful refreshments would be deducted from the time allotted for the examination. This speech took away Shaw's attention from his sheets for a moment, but it also had the redeeming quality of taking away his appetite.

These disturbing influences together with the rattling of cars outside, and the hoarse calling of hawkers hawking their wares, coming in blatant blasts at the open windows mixed with echoes of "Auld Lang Syne" from a melancholy but persistent barrel organ, produced a kind of pandemonium, differing from, but fully as clamorous as a gang of riveters working overtime on a belated boiler. The effect was to produce a kind of St. Vitus' dance in the bewildered brains of the busy boiler inspectors.

Some stole out quietly as if they had forgotten something. One hard-featured, sober-looking veteran eyed the others askance as if he was wondering what they could be writing about. At last he began with a trembling hand. Presently a dark cloud of muffled melancholy settled upon him. He tore a few garbled notes to atoms, like a poet in the first spasmodic throes of inspiration, and departed, a sadder if not a wiser man. A keen-eyed competitor snatched up the fragments and pored over them, like a solitary philosophic soul grappling with a Chinese puzzle. A cross-eyed candidate was cautioned twice against looking over his neighbor's shoulder, and on being approached by the watchers the third time he walked out as if bent on plunging into the elevator shaft, but his feet led him into the supply closet, and he was finally ejected by the policeman.

Shaw was in at the finish, with a few others. The large majority who had left convinced that they could not qualify under such conditions were holding an indignation meeting in a near-by hostelry. If they could not make boiler inspectors of themselves they could at least make tanks of themselves. Their comments on the Civil Service laws would make good reading, but the soft, metal type would hardly stand the sulphurous heat of the epithets hurled blindly at the heads of the learned men who had formulated the questions. A strong desire was unanimously expressed to meet them personally for the purpose of working upon them with a wooden maul, better known as a flanging hammer. A committee composed of three of the most eloquent candidates, was appointed to lay the matter before the mayor, but before they had reached the marble portals of the City Hall they were almost past speaking, and not being qualified in the use of the deaf and dumb alphabet, the committee silently agreed to report progress, although, as usual with such committees, no real progress had been made.

The Legislature had other uses for the money that was in the State Treasury, and no appointments were made. Political office-seekers rarely get what they ask, but something equally as good sometimes comes their way. Shaw's name appeared on the eligible list, and, it so happened that the Anti-Corrosive Boiler Insurance Company were engaging extra inspectors and Shaw received an appointment. When he took office and wore a white metal badge, evidently the product of the American Pie Plate Company, his chest swelled to abnormal proportions. The boarding mistress took a new view of Shaw. He was allowed to smoke in the parlor —the highest privilege known in the Dutch widow's boarding house. But Fate was against Shaw. Coincident with his appointment in the Boiler Insurance Company came a third assistant to the second vice-president. His salary depended largely on his ability to reduce expenses. Seven of the new inspectors were suspended at one fell swoop, and among them was Shaw.

He is back in the tool room again. He still wears his pie-plate badge, and also an air of profound melancholy. When he gathers up courage to look at the boarding mistress she gives him the frozen face and the cold potatoes. There is this much that remains to be said of Shaw, however, that in spite of disaster after disaster, and trials that have never led to triumphs, Shaw is not dead yet. He is taking boxing lessons from Macfarlane, and there is something going to happen to someone in the near future.

Railroad Notes.

The International & Great Northern proposes to order 20 new locomotives.

The Santa Fe proposes to construct repair shops and a roundhouse at National City, Cal.

The Wabash is getting 20 locomotives repaired at the Lima Locomotive Works at Lima, O.

The Norfolk & Western has contracted for 15 Mallet locomotives from the American Locomotive Company.

The Santa Fe has let the contract for a 15-stall roundhouse at Calwa, Cal., near Fresno. The structure will be of concrete and modernly equipped.

The Delaware & Hudson are expending about $2,000,000 on new shops and shop equipment near Troy, N. Y. The plant is to be completed by July, 1912.

The fourth annual convention of the International Railway Fuel Association will be held at the Hotel Sherman, Chicago, May 22 to 25. D. B. Sebastion, Rock Island, Chicago, is secretary.

Lord Strathcona, high commissioner for Canada, in London, was informed by cable, from the Minister of the Interior at Ottawa, that railway construction work in western Canada will need 60,000 men, the lowest wages being now $2.50 a day, or $5 a day with a team of horses.

Consul General Thomas Sammons, of Yokohama, reports that the earnings of the Japanese Imperial Government railroads continue to increase. For July and August, 1911, the total receipts from passengers carried amounted to $2,154,827, while those from freight were $1,699,447. This shows an increase of $380,000 in passenger receipts and $439,500 in freight receipts over the same period last year.

Title to large tracts of coal land near Durango and Trinidad, Colo., has been taken by Julius Kruttschnitt, vice-president of the Harriman lines. They had been held in trust by the International Trust Company under an agreement of sale from the Colonial Land & Development Company. It is supposed the intention is to some day build the Southern Pacific from Clifton, Ariz., to the Colorado coal fields. A final survey has been made.

Track laying on the Grand Trunk Pacific's main line has been completed to the summit of the Great Divide, between Alberta and British Columbia, 1,024 miles west of Winnipeg, leaving a gap of but 79 miles, the closing of which will witness the solution of the transportation problem for a great part of the country. When the entire road is finished Tete Jaune Cache and Ft. George will be only 184 miles apart. The latter place is to become one of the great distributing points of the province.

Another grand division is to be formed on the Pennsylvania to be composed of scattered lines in Ohio and known as the middle division of the lines west of Pittsburgh. It will comprise 1,000 miles of track. The consolidation last summer of sundry independent roads was the first step. The organization will be similar to that of the Northwest and Southwest system.

Announcement has been made by the Canadian Northern Railway that authority to tunnel Mount Royal for terminal entrance to the heart of Montreal, Que., will be asked of the Canadian Parliament next session by the Canadian Northern Montreal Tunnel & Terminal Co., Ltd. This enterprise will involve an expenditure of $25,000,000. The tunnel will be three miles in length. It will materially expedite entrance to the city.

The average earnings per locomotive per day in the East are $124.84, and on the western roads, $130.84. The highest earnings in the West are those of the Santa Fe locomotives, which work out at $149.53 per day. The highest earnings in the East are on the Central Railroad of New Jersey, where the average is $147.06 per day.

The Montreal Locomotive Works booked the following orders for locomotives: Roger Miller & Son, Toronto, two four-wheel saddle tank locomotives (040-T type), cylinders 11 x 16 in., driving wheels 33 in., and total weight in working order 39,000 lbs.; P. Lyall & Sons, Ltd., Montreal, one four-wheel saddle tank locomotive (040-T type), cylinders 13 x 18 in., driving wheels 36 in., and total weight in working order 56,000 lbs.

The Grand Trunk has placed orders for twenty switching engines and ten Richmond compound consolidated engines. Ten of the switching engines are to be built by the Lima Locomotive Works, Limited; ten by the Montreal Locomotive Works, and the Richmond compound engines by the American Locomotive Company, Schenectady, N. Y. The working pressure of the switch engines is 100 lbs. Delivery will begin next month.

The declaration of an initial semi-annual dividend of 3½ per cent. on the $20,000,000 preferred stock announced by the directors of the Baldwin Locomotive Works is especially encouraging to the security holders in view of the fact that last year was one of the worst equipment industry has ever experienced. The Baldwin works, in particular, were seriously hampered by labor troubles. For the coming year the outlook is excellent.

Some disappointment was felt when it was announced, though unofficially, that the New York Central Lines had placed an order for 115,000 tons of steel rails, instead of the expected 180,000 tons. The bulk of the contracts go to the Lackawanna Steel Company, and the United States Steel Corporation. The Pennsylvania announcement is looked for this week, and the belief is expressed that it, too, will fall below expectations; it has been expected that the order will call for 150,000 tons.

The Canadian Pacific Railway is planning a new terminal for through freight which will cost about $7,000,000. This line is said to have, at Winnipeg, the largest car yard in the world. There are 132 miles of track, with accommodation for upward of 3,000 cars. Although this yard was planned for both local and through freight, a new terminal for through freight is now necessary; engineers are making plans for a clearing yard, with accommodation for 5,000 cars, which involves placing 50 miles additional trackage.

Mr. Samuel Rea, president of the New York Connecting Railroad Company, announces that the contract for the steel work for the approaches to the East River Bridge on Long Island, Randall's Island and in the Bronx has been awarded to the McClintic-Marshall Construction Company. Contracts for the steel work for the East River Bridge and its Long Island and Ward's Island viaducts were previously awarded to the American Bridge Company. Today's award covers all of the steel work required for Bronx Kill and Little Hell Gate bridges and the remaining approach viaducts.

The Delaware & Hudson Company will complete in July, 1912, a modern locomotive and car repair shop, at a cost of approximately $2,000,000. The shop lay-out also provides for a large modern engine house and car-cleaning facilities. During the last five years the Delaware & Hudson Company has spent in the neighborhood of $17,000,000 for new equipment without making any extensive enlargement of its shop facilities, and the new shop is to take care of the needs on this account. The shops are located on a piece of property of 180 acres in area midway between Albany and Troy.

The Bessemer & Lake Erie Railroad has placed with the two steel car building companies of Pittsburgh contracts for 2,000 all-steel hopper and gondola cars, for coal and ore traffic, adding to the order books of the plate mills of the United States Steel Corporation some 24,000 tons of plates for immediate production. The Delaware, Lackawanna & Western has ordered 200 refrigerator cars from the Standard Steel Car Company. The New York, New Haven & Hartford Railroad has ordered three electric locomotives from the Westinghouse Electric and Manufacturing Company. The American Locomotive Company will build four locomotives for a Brazilian road. The Grand Trunk Railroad Company is to build thirty locomotives, mainly at the Montreal shops.

An order for 155 new steel passenger coaches just placed with the American Car & Foundry Company for the New York Central lines has aroused interest because of the announcement that this is the third extensive order given by that system within sixty days for new equipment that altogether involves an expenditure of over $23,000,000. An order has also been placed with the American Car & Foundry Company by the Chicago, St. Paul, Minneapolis & Omaha Railroad for 50 box and 100 refrigerator cars. The Rock Island has ordered 2,500 cars and the Steel Corporation will buy 3,000, of which 2,000 are for the Pittsburgh, Bessemer & Lake Erie, and 1,000 for the Elgin, Joliet & Eastern. Contracts have been closed by the Maine Central with the American Locomotive Company for the construction of 7 consolidated superheater freight, 2 Pacific superheater passenger and 2 six-wheel switching locomotives.

New Branch Office.

The New York sales offices of J. A. Fay and Egan Company were located in the Equitable Building, recently destroyed by fire. The office force escaped, but all records and correspondence were destroyed. New offices have been opened at 170 Broadway, and all customers, past and prospective, are being rapidly placed in communication with the new office, and business is being proceeded with in the usual prompt and efficient manner of the enterprising company.

Books, Bulletins and Catalogues

Prevention of Railroad Accidents.

A heart to heart talk with railroad employees by Mr. George Bradshaw under the above title forms the subject of a compact volume, and a perusal of which could not fail to aid in reducing the number of accidents on railways to a minimum. The author is a well-known railroad man, for many years engaged in the investigation and settlement of claims for personal injuries and deaths resulting from railway accidents. The book is fully illustrated, mostly by original photographs. The work extends to 174 pages, handy pocket size, and is published and sold by the Norman W. Henley Publishing Company, New York. 50 cents per copy.

American Vanadium Facts.

Last month's issue of this illustrated Bulletin deals largely with tool steel, and presents in a brief and engaging manner much that is of real value to those who are interested in the recent marked improvements in the manufacture of fine tools. The use of Vanadium in the construction of many parts of recent locomotives is also described, with many testimonials from leading firms in regard to the merits of Vanadium in the manufacture of steel. Copies may be had from the Vanadium Sales Company of America, Frick Building, Pittsburgh, Pa.

Steam Trap.

W. H. Nicholson and Company have recently issued an illuminated bulletin in regard to their "Wyoming" weight operated steam trap. This device is meeting with much favor, and has several features distinctively its own, and all of real value. It may be briefly stated that while it is of the float operated type of trap, no dependence is placed upon the buoyancy or weight of the float to lift the discharge valve, as is usually the case. The valve weight consists of a levered cast iron ball, the weight of which governs the capacity in size of hole through the discharge valve seat. By merely increasing the weight of the valve weight a discharge valve of almost any size can be operated. This is the reason why the capacity of the "Wyoming" is so much larger than that of other traps. The opening and closing of the valve are automatic and instantaneous. There is no lingering wire-drawing in the operation of the "Wyoming." Send for a copy of the descriptive illustrated bulletin to W. H. Nicholson & Company, Wilkes-Barre, Pa.

H. K. Porter Locomotives.

We are pleased to observe that the H. K. Porter Company of Pittsburgh, Pa., who began the building of light locomotives about 50 years ago, and whose engines have been growing heavier and heavier ever since, are now chiefly engaged in what may be termed the manufacture of the heavier types of locomotive. While the locomotives they manufacture have become heavier, the same distinctive features are retained. The conditions are not greatly changed. There are still the same steep grades, sharp curves, loads often beyond rated capacity, and long continued service, frequently with two or three crews in the twenty-four hours day after day. The works have grown, and are keeping pace with the requirements of the most advanced locomotive construction. Their specialties embrace steam locomotives, wide and narrow gauges, in every variety of design, and from 3 to 150 tons in weight. Compressed air and gasoline locomotives are also being manufactured by them, and it should be remembered that the company have always a number of 4-wheel connected saddle-tank locomotives ready for immediate shipment. Send for a copy of their latest bulletin to the office, Union Bank Building, Pittsburgh, Pa.

Boiler Tools.

The J. Faessler Manufacturing Company, Moberly, Mo., has issued an illustrated folder showing the Faessler octagonal sectional expanders, roller expanders and flue cutting machine. Full of good arguments and facts worth reading and knowing. All interested in high class boiler tools should send for a copy of the folder.

New Chart.

The Norman W. Henley Publishing Company, New York, has just issued a chart of a modern submarine boat with 200 parts named and numbered. The cross section view shows very clearly all of the interior of a submarine of the latest type. It has been approved by naval engineers, and is sent by mail to any address for 25 cents per copy.

Draft Rigging.

Our Engineering Bureau has just received from the T. H. Symington Company a new and very attractive booklet illustrating and describing the Farlow draft rigging. The subject treated is divided under three headings—Mechanical Construction, Transportation Features, and Economics. The methods of assembling is illustrated for the benefit of car foremen and others, and

the proper application to the car frame is described. Copies of this little book may be had upon application to the T. H. Symington Company, Maryland square, Baltimore, Md.

A Planer and Matcher and Medium Sizer.

Illustrated herewith is shown a heavy planing, matching and medium timber sizing machine, indicated by the makers as J. A. Fay & Egan Company's No. 171 double cylinder planer, matcher and medium sizer.

This machine has established the makers' claim, to a wide reputation throughout the United States because of its durability in working material 20 ins. or 30 ins. wide and 12 ins. thick. The reason for its durability is obvious after one examines the frame which is extremely heavy, strongly ribbed and girted throughout.

The feed consists of six double-geared feed rolls 9 ins. in diameter. Of the four feed-in rolls, the two upper ones are carried on the same pair of slides, and pressure is maintained by double compression springs. On the 30-in. machine these upper rolls are in two sections. The lower feed-in rolls and bar before lower cylinder are simultaneously adjusted by means of a hand wheel at the feed-in end of machine for the purpose of equalizing the cut when it would make an excessive cut for the top head. There are two feed-out rolls driven by steel roller chain. Pressure for the upper feed-out roll is also maintained by double compression springs. The raising screws for both are started by tight and loose pulleys, operated either from the feed-in end of the machine or the left side.

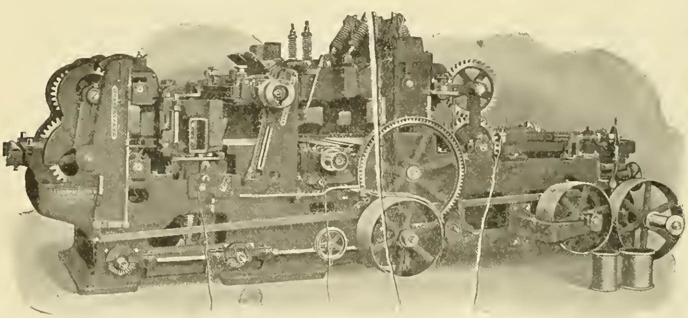
A power-raising and lowering attachment adjust the upper feed rolls and cylinders, or they may be adjusted independently by hand. Each has a separate brass index plate.

Matcher spindles are carried in self-oiling bearings. The lower bearing carriers and also the step bearing is vertically adjustable for lining the heads. The upper end of the spindle is supported by a rigid top bearing.

The pressure bars before and after cut of each cylinder have vertical and lateral adjustments. The chip breaker and feed-in rolls before the upper cylinder on 30-in. machine are made in two sections to permit dressing two pieces of uneven thickness at the same time. These bars all adjust sufficiently to permit the cutting of molding 1 in. deep.

Cylinders are of solid forged steel, four-sided and slotted on each side, and are double belted. The lower cylinder draws out at side of machine to give access to the knives and is adjustable for varying the amount of the cut. The upper cylinder is raised and lowered on screws, mounted on ball bearings. The lower cylinder cuts first.

For further particulars concerning this machine, write the manufacturers, J. A. Fay & Egan Company, 445 West Front street, Cincinnati, Ohio, who make a standard line of woodworking machinery.



PLANER, MATCHER AND SIZER.

Got Satisfaction.

A well-known French actor became involved in a discussion with an American, grew heated, drew his card from his pocket, threw it on the table with a tragic air, and stalked out.

The American regarded the card for some moments, then took out his fountain pen, wrote "Admit bearer" above the engraved name, and went off to the theater.

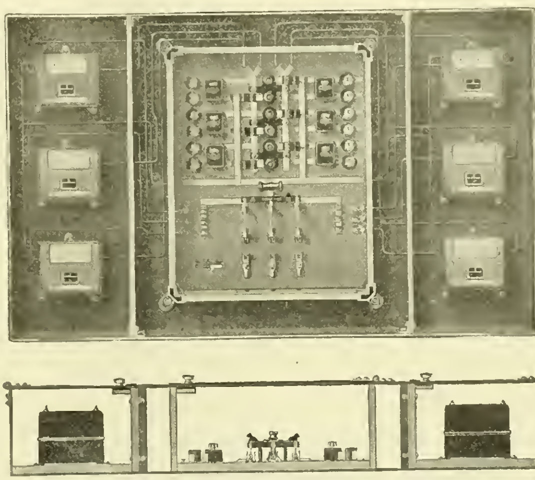
He Ought To.

"How old is your baby brother?" asked little Tommy of a playmate. "One year old," replied Johnny. "Ah!" exclaimed Tommy, "I've got a dog a year old and he can walk twice as well as your brother." "Well, so he ought to," replied Johnny, "he's got twice as many legs."

Panels and Cabinets.

The Crouse-Hinds Company of Syracuse, N. Y., have recently issued their first bulletin, a superb catalogue of 80 pages, with numerous illustrations, giving full details, with accompanying price lists, in regard to the advanced principles applied to the Multimeter Panel Board—a new Crouse-Hinds product, which are such pronounced advantages as to recommend it to owners of buildings where tenants have individual meters, and where the units of rented space are subject to frequent change. By its use electric circuits can be switched from one meter to another without necessitating any alteration in the wiring.

The characteristics of the Multimeter panel are many. Individual meter bars are arranged in two vertical laminated sets in the center of the panel board, supported and separated by insulating pillars and spacers. Terminals feeding to the meters are located on each side of the mains at the bottom of the panel board, and are arranged for N. E. C. enclosed or Edison plug fuses, as desired. The upper ends of the meter bars are equipped with terminals for receiving the return wires from the meters. On each side of the panel board, above the meter leads, is placed a binding nut for potential wire connections.



CROUSE-HINDS MULTIMETER PANEL BOARD.

The accompanying reproduction of a Multimeter panel board evidences its compactness. Here is shown a panel that is arranged so that any desired change in circuit can be made in the time required to pull out and insert a connection clip —at most, a few seconds.

Copies of this valuable bulletin may be had on application.

That Might Do.

Customer: "What's this, waiter?"

Waiter: "That's sole, sir."

Customer: "Well, just take it away and bring me a bit of the upper with the eyelets removed."

We have been hearing a great deal on this side about iniquitous things being done in restraint of trade, especially by railway companies and now the Germans are accused of similar transgressions. The formidable character of his name may have brought him under suspicion, but a charge of monopolizing certain shipping business in Germany has been brought against D. A. Dampfschifffahrts gesellschaft with excellent prospects of conviction.

The Duke of Westminster is one of the richest men in Great Britain, and he has a habit of always riding third class when he travels on railways. A friend was expostulating with the duke one day about this habit. "Why do you always ride third class?" asked the friend. "The difference in price cannot affect you. Why do you do it?" "Well," replied his grace, "I ride third because there is no fourth class."

"When I look at my congregation," said a London preacher, "I say, 'Where are the poor?' When I count the offertory in the vestry I say, 'Where are the rich?' "—*Boston Transcript.*

Few causes age the body faster than wilful indolence and monotony of mind —the mind, that very principle of physical youthfulness.—*J. L. Allen.*

Locomotive Engineer's Pay.

As we go to press there is a conference going on between the officials of railroads East of Chicago and representatives of the Brotherhood of Locomotive Engineers on questions relating to pay. The engineers are seeking to have their regular and overtime wages governed by "cylinder diameter" on each of the forty-eight railroads. The scale they have advanced to the railroad operators for consideration is in part as follows:

Passenger engines with cylinders of 20 ins. or less in diameter, $4.40 per 100 miles or less. Engines with cylinders over 20 ins. in diameter, $4.60 per 100 miles or less. Miles made in excess of 100 pro rata. Overtime in through passenger service to be computed on a basis of twenty miles an hour. Overtime will be paid for at 70 cents an hour.

Wherever electric service is installed or now in operation locomotive engineers will take the positions on electric locomotives or multiple unit trains under the prevailing schedules governing rates of pay and conditions in steam service.

Freight engines with cylinders of 20 ins. in diameter or less, $5.25. Engines with cylinders over 20 ins. in diameter and less than 24 ins. in diameter, $5.50. Engines with cylinders 24 ins. in diameter and over, except Mallets, $5.75. Mallet type of engine, $7.

Latest New Jersey Legislature Strike.

Mr. Oscar F. Ostby, general manager of the Commercial Acetylene Company of New York, whose principal factories are in New Jersey, has given the public facts that are causing the greatest sensation that the legislators of New Jersey have encountered for some years. Senator Fitzherbert had introduced bills prohibiting the use of acetylene gas on railroad trains, as also prohibited the manufacture of such gas within one thousand feet of any dwelling.

Meanwhile a certain Dr. Ridner had approached Mr. Ostby, as head of the Commercial Acetylene Company, and intimated that for five thousand dollars he could get the disastrous bills withdrawn. Mr. Ostby kept this Ridner on the hook of suspense, engaging him in interviews that were reported by a stenographer hidden in a spot where the conversation could be overheard. Then Mr. Ostby went before the Judiciary Committee of the Senate and revealed particulars of the plot to obtain money as a consideration for suppressing the bills.

Senator Fitzherbert said that Ridner was one of the slickest fellows in Trenton and could get about what he wanted from the Legislature. He also said that Ostby ought to have given Ridner the money.

Railroad Heroes.

At Cumminsville, Ohio, an old lady named Mrs. Potts was warned not to cross the track as a locomotive of the Cincinnati, Hamilton & Dayton Railway was approaching. Mr. James M. Rose, one of the company's switchmen, ran to her rescue as she persisted in crossing. Mr. Newton Joyce, a street conductor, also joined in the rescue. In some way Mrs. Potts fell on the track, and before the two men succeeded in raising her all three were struck by the locomotive and killed almost instantly. The heroic incident has aroused much sympathy in the community.

A Wonderful Machine.

When I was laying the foundation of my mechanical fame and fortune running a bolt cutter in the Rock Island shops at Chicago, some years ago, I boarded in a house filled with locomotive engineers and firemen. There were a few machinists, but their voices and votes were lost among the enginemen.

A practice prevailed there of enlivening the supper table with social conversation, and the locomotive men being in the majority, the leading theme of talk was stupendous feats performed in getting over certain hills without doubling. This was occasionally varied by the record of minor incidents, such as the exploit performed by Tom Briggs when the 796 broke her rocker arm; how narrowly Dick Norris escaped from having his checks called in when the 1187 broke her side rod running down Valley Hill; how Harry Kenney whooped up the 492 to make a meeting point, and just got clear into the siding when the Chicago Limited rushed past.

James Kennedy, who ran a lathe in the shop, sat opposite me at the table, and he got tired of being excluded from the conversation. He became ambitious to hear himself talk in that crowd. One evening, catching on in a lull of the talk, he called out loudly to me: "Well, I went over and saw that new machine today, and it is astonishing the fine work it does."

"How does it work?" I inquired.

"Well," said James, "by means of a pedal attachment, a fulcrumed lever converts a vertical reciprocating motion into circular movement. The principal part of the machine is a huge disc which revolves in a vertical plane. Power is applied through the axis of the disc, and when the speed of the driving arbor is moderate, the periphery of the apparatus is traveling at high velocity. Work is done on this periphery. Pieces of the hardest steel are by mere impact reduced to any shape the skillful operator desires."

"What in thunder is that machine, anyway?" demanded Tom Briggs.

"Oh, it's a new grindstone," replied James, and a silence that could be cut with a butter knife fell upon the crowd.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

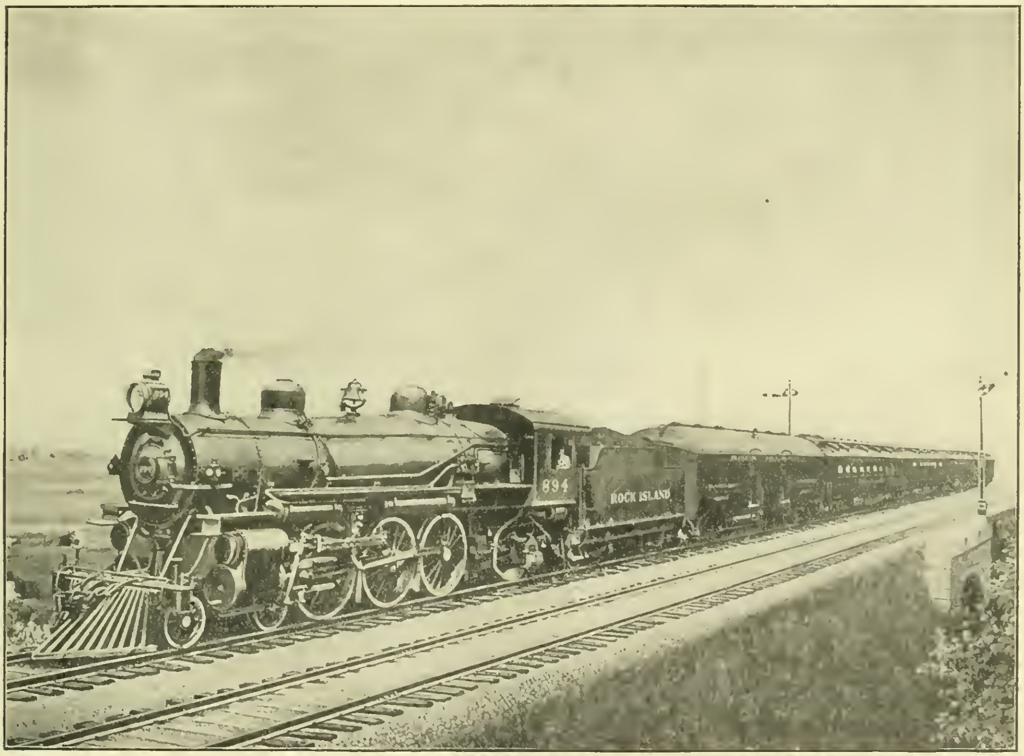
Vol. XXV. 114 Liberty Street, New York, April, 1912. No. 4

On the Golden State Limited.

During the wild winter through which we have happily passed those of us who were fortunate enough to be able to make a brief sojourn in the land of everlasting June, nothing could be imagined finer than a trip on the Rock Island Lines' Golden State Limited train de luxe to California. This train operates between Chicago, St. Louis, Kansas City and El Paso, Los Angeles, Pasadena, Santa Barbara, Del Monte and San Francisco.

The route over which this train is operated is the direct route of the low altitude through the ever interesting and oft-times enchanting Southwest. From Kansas City westward there is little danger of stopping over for a day or two while the snow plough clears the cuttings down the line. The road is kept clear by the constantly increasing traffic, and when the Golden State Limited comes along everything seems as if prepared for a royal progress, and the train passes from State to State and from zone to zone with an ease and elegance begotten of the highest kind of scientific management, and from the frozen North one passes through an ever-moving panorama of far-spreading prairies where the cattle wander at will, and by mountains, mist-mantied and white-crested, and anon into flower-spangled expanses where the winter wind never comes, and where the green fields and woody wilderness seem forever in bloom.

Of the train itself it may be truly said that the general feeling of gladness common to travelers who safely reach their journey's end seems to be reversed in the case of the Golden State Limited. The lovers of comfort and elegance and the ever-varying kaleidoscope of nature in her full-blossomed beauty and serene solitude, hate to leave the luxurious cars. It



GOLDEN STATE LIMITED. ROCK ISLAND LINES.
Copyright Detroit Publishing Co.

is one of the very few solid Pullman trains throughout, exclusively for first-class passengers, the equipment comprising drawing-room and stateroom sleeping cars, buffet-library observation car and dining car. It is generally claimed by travelers of much experience that there are numerous unique features which mark the Golden Gate Limited as the finest of that exclusive class of superb trains to which it belongs.

The buffet-library-observation car is something new and is perhaps the crowning feature of the train. A spacious salon draped in soft silken curtains; aloft are clustered chandeliers that glitter into electric fretted fire when the sun goes down. There is an elegant cabinet Victrola that warbles select recitals at proper intervals. Caruso and Tetrazzini and Harry Lauder seem to be with us. Telegraphic news bulletins are recording the news of the outer world as we pass from town to town. The cream of literature is here—poets, romancers, historians—selected by men of sense. Current magazines, periodicals, newspapers, stock market reports; the pulses of Wall Street are beating right here. Then there are writing desks, with embossed stationery, a buffet with solid refreshments, a barber shop, valet service for pressing garments, a telephone, connected at terminals. It beats home, sweet home. It is the choicest regions of the most exclusive club land on wheels. It is a combination of all that is known in elegance in travel, and a journey of this kind is worth waiting a lifetime to crown, as it were, our weary wanderings with one glad, golden journey.

In a Snow Drift.

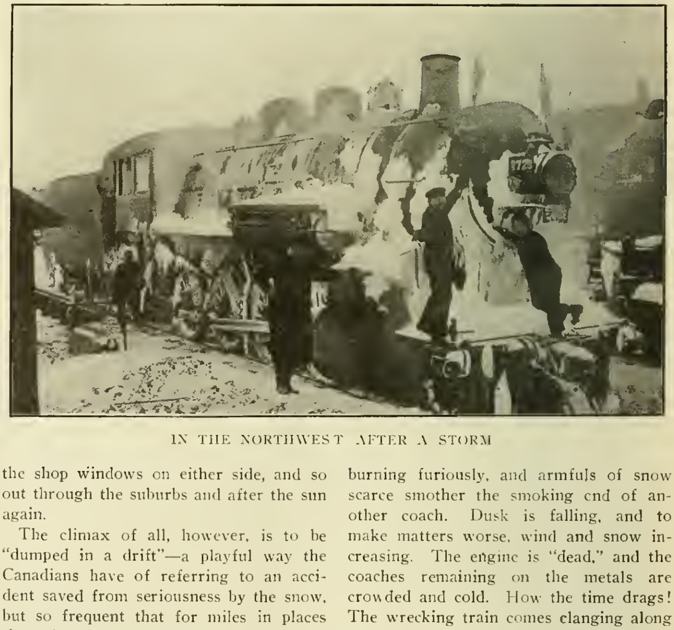
Roughing it in the Northwest on an emigrant train is less liable to moving accidents than formerly, but, according to Mr. E. Pearse Wheatley, in the London *Railway Magazine*, it still has its interesting incidents. In describing an experience in Ontario he asks:

What is there, for instance, like rushing over the darkening prairie after the setting sun, on every hand, "miles and miles of unturned loam and miles of unused sky," the great quiet of a calm night settling with the dusk, the metals gleaming like lines of fire until they meet and dip over the horizon far behind, and the smoke from the engine lying like a monster log as far? How would you like to feel the jar an obstinate bullock gives the train when he tries conclusions with the engine, or wait patiently while long lines of cattle cross the metals?

Or how would you enjoy being sidetracked for half a day in the New Ontario wilderness of rocks and forests while they cleared away the wreckage of an erring freight train ahead, and, your provisions all gone, regale yourself on the raspberries and blueberries growing thick by the side of the track, trying to believe you were not hungry? How would you care to stop over for a day or two while the snow-plough cleared the cuttings down the line, and then travel in a carriage darkened by towering snow walls that almost scraped the windows, and were level with the top of the train? How would you like to feel the coach bump and jolt like an untamed colt because the frost had "heaved" a few sleepers, or hear every wheel shriek in agony at the right-angled curve which prevented the train from tumbling into the river hundreds of feet below. Perhaps you went to sleep, soothed by the smooth song of the wheels over the prairie, and awoke cold and cramped to watch the clouds swirling among snow-capped peaks while day dawned; and then you traveled through a fair-sized town straight down the main street where you could throw a biscuit into the shop windows on either side, and so out through the suburbs and after the sun again.

The climax of all, however, is to be "dumped in a drift"—a playful way the Canadians have of referring to an accident saved from seriousness by the snow, but so frequent that for miles in places the sleepers are tattooed with marks of train wheels, *mostly* freight trains. Imagine a crowded "Colonist," steaming along by Lake Superior — inside all warmth and noisy comfort, outside snow-covered trees, and never a break on the white carpet below, save an occasional animal track! It is nearing noon, and numerous dinners are preparing on the big stoves at the end of each car. The immigrants are enjoying themselves hugely, some being in the pull-out berths overhead, others reading or playing cards or watching with lanquid interest the rising snowstorm outside. Suddenly the brakes hiss with such force that the big car trembles. The next moment it bumps and jolts with nerve-destroying shocks, then sways from one side to the other until, with a headlong rush, everything falls down, down, down, and, amid a ruin of all things movable, children scream and men shout. The car quickly fills with smoke, but luckily the top of the stove has jammed and the fire is imprisoned.

Springing for axe and bar, kept in a handy glass case in every car on every train, somebody chops furiously at the windows, now overhead. There is wreckage, smoke, and dust enough for a fearful accident, but the kind snowdrift has saved them. Quickly the children and women are handed up and out, then the men help each other, and presently most of the baggage is saved. But what a sight meets your eyes outside! Six or eight coaches have buried themselves in the snow, the "caboose" or guard's-van is



IN THE NORTHWEST AFTER A STORM

burning furiously, and armfuls of snow scarce smother the smoking end of another coach. Dusk is falling, and to make matters worse, wind and snow increasing. The engine is "dead," and the coaches remaining on the metals are crowded and cold. How the time drags! The wrecking train comes clanging along and a car standing on the sleepers is put back on the rails. At last a special train is rushed up—the nearest station either way is 40 or 50 miles away; the nearest town of any size 100—and westward again the immigrants speed, leaving nothing but a bonfire or two, some heaps of wreckage, a spread rail and the dark, dumb woods witnesses of what might have proved grim tragedy. The snow has probably saved the life of every soul aboard, but as they hurtle through the night, *sans* heat, *sans* food, *sans* light, and with nerves shrinking at every bump, the immigrants do not bless the snow.

Efficiency of the Locomotive.

We recently heard a mechanical engineer of some professional standing make the statement that "the locomotive is the most inefficient form of engine that uses steam." That statement was made with supreme confidence, yet it was based upon a ridiculous combination of ignorance and prejudice, conceived in error and brought forth with the intention to deceive.

Members of the engineering fraternity ready to express authoritative opinions concerning motive power ought to know that a well proportioned, skilfully built and properly handled locomotive is a more economical steam user than the ordinary stationary engine, and that high-class automatic or condensing engines display a very small margin of economy over a good locomotive. An engine of this kind hauling a passenger train that can be handled easily, does the work on an expenditure of about twenty pounds of steam per horse power per hour. The ordinary freight engine will use double or treble that amount of steam for the simple reason that freight locomotives are habitually overloaded, and must permit the steam to follow the piston so far at full pressure that the terminal pressure is naturally very high. Passenger locomotives that are heavily loaded and are worked hard to make running time, and have to be forced rapidly into speed after frequent stoppages, will use nearly as much steam per horse power as a freight engine. The fact that a locomotive is using twice the amount of steam which ought to be required in doing a certain amount of work is really no reflection upon the engine but generally is the fault of the system that calls for overloading.

Remember the Good Old Days.

The luxury of railway travel is so uniform now-a-days that it is difficult to remember the times when a railway journey was anticipated with dread, when a night journey loomed up as a nightmare. It is not yet going into the realms of ancient history, for people to recall the days when through cars had not come into use. It was then we changed cars early and late, especially after midnight, and we went through the ordeal without a murmur or a cross word because we took it as a matter of course.

In those "good old days" it was considered great good luck to get an entire seat to one's self, and a good night's rest curled up thereon, if the conductor did not call for tickets more than four times during the night. Then when the morning came how delightful it was to enjoy the brief toilet made by dipping the corner of a handkerchief at the solitary tumbler of the water cooler. There were no toilet rooms for ladies to lock themselves in against all others, so that serene harmony prevailed. When the conductor's appetite was such that the train stopped full twenty minutes for dinner, it was luxury indeed, and failing the twenty minutes' stop, we considered it good fortune when during a five minutes' stop the natives crowded upon the cars to sell pies and sandwiches and hot dogs.

It is different now and the passenger is a little spoiled and can hardly work up any grievances concerning the discomforts of the journey. So long as he is ready to pay the price he expects the accommodation of a compartment to himself, fitted up with all the dainties and luxuries of a lady's boudoir, and receives it. Talk of enervating habits. The modern railway journey is the most enervating experience of modern life.

The Value of Economy.

Very striking have been the recent appeals of large railroad corporations to their employees, to practice daily economy in the interest of the companies. Some roads have gone to great lengths to show each employee how he can save five cents a day, and the total of such a saving is a staggering sum. One of the large systems has prepared an interesting table, illustrating the difficulty of earning money and the ease with which it can be disbursed. To earn a two-cent stamp, the road must transport a ton of freight three and one-half miles; to pay for a lead pencil requires the road to haul the ton two miles further; it has to be carried ten miles to pay for a pound of waste, and seventy-five miles to pay for one red lantern globe and one hundred miles for the entire lantern. Carelessness on the part of employees in these minor matters affects vitally the financial prosperity and credit of the road, and may impair dividends and delay just increase in wages. In countless ways it will tend to injure the best welfare of employer and employee. Rigid economy spells success.

This principle of carelessness in expenditure and economy in the use of materials should be followed by employees everywhere, whether a specific appeal is issued to them or not. It is the right principle. It promotes the general welfare. Money and materials should not be wasted; both are too valuable. The worth of money should be measured not by what it will buy, but by what it will earn. It takes a dollar, invested at four per cent., six months of continuous work to earn a two-cent stamp. A sheet of good letter paper wasted will absorb the earnings of a dollar at three per cent. for two entire months.

Saved the Express.

A signalman who had been off duty through illness a considerable time started to work before he had fully recovered his good health, and his thirteen-year-old boy, on taking his tea to the box, found his father too ill to attend to his work.

Making his father as comfortable as possible the boy went to the train register, where all signals sent and received are inserted by the signalman on duty, and saw that his father had received the "line clear" signal for the South express. Turning to the levers, however, he was horrified to see that the signals and points were put for the goods line. It was very foggy at the time, and while on his way to the box he had noticed a mineral train standing on the goods line directly in the way of the oncoming express.

The boy had on previous occasions spent a good deal of time in the box with his father, who had explained all the details of its complicated workings. It now served him in good stead. He reversed the levers of the goods road, and put the points for the express passenger line, then pulled off the signals just as the box in the rear rang up and gave the train-entering sectional signal.

In a few minutes the train rushed past, none of its precious passengers ever knowing how that journey would have terminated had it not been for that cool and brave boy.

Acetylene Gas in New Zealand.

Three towns in the South Island of New Zealand of 3,000 to 5,000 population, Picton, Queenstown, and Kaipoi, at present have central acetylene generating stations. The New Zealand Railway Department makes considerable use of acetylene for locomotive headlights and for lighting stations, about 120 tons covering this year's requirements, having recently been imported from the United States. One manufacturer of acetylene generators in Wellington has installed about 450 plants in various parts of New Zealand and lights several small towns for about $5,000 a year each.

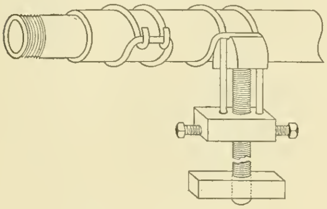
Another local manufacturer of acetylene generators, in order to encourage the use of acetylene, sells carbide at cost price, this amounting to about 4 cents per pound (landed cost) for the best quality. This company claims that a 500-candle-power acetylene light in New Zealand costs only 60 cents per hour, whereas kerosene costs about $1.35 per hour, coal gas with Welsbach burners about 90 cents, and electric light, except where cheaply developed from water power, about $1.50 for the same amount of light. The rapidly increasing use of motor cars in New Zealand is increasing the use of acetylene lamps, and it looks as if the price of the product will decrease.

General Correspondence

Hose-Coupling Device.

Editor:

A home-made hose-coupler, shown in the accompanying drawing can be made by any machinist in a short time and with very little material. It will prove to be a very handy and effective tool on locomotive roundhouse work for coupling rubber hose. As will be observed, the soft iron or copper wire is held in place by two adjustable set screws, and a little manipulation which will readily suggest itself to an intelligent mechanic, and the doubled wire is clasped around the joint of the hose with a degree of tightness that leaves nothing further to be desired. The ends of the wire may be readily clipped off or cut with a file as convenient. The tool has done good work here, and the couplings of hose that have been made by it have never begun to come apart. The new devices published by you are all clever, and I hope that the enclosed has sufficient merit to find a place in your correspondence department.



HOSE-COUPLING DEVICE.

Montreal, Canada. J. G. KOPPELL.

Engine Blower.

Editor:

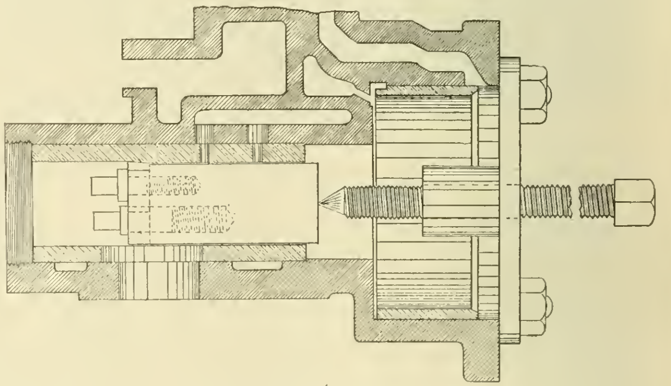
The Northern Pacific Railway Co., at So. Tacoma, is trying out a patent blower on one of their large freight engines here. This blower was invented recently by Mr. C. W. McKenna, master mechanic of the Northwestern Improvement Company at Roslyn, Wash.

The device consists of two small turbine engines with blowers attached, one on either side of the boiler connected with side openings into the ash pan.

In addition there is an induction draft, caused by the exhaust, at the front end of the boiler. The new device differs mechanically from the old method in that the induction draft is only used on the engines at present. In the working out of the new method the induction draft is equalized to a certain extent by the air that is forced under the grate by the turbine engines. Sufficient force is left, however, to the induction draft to draw the gases through the flues and out of the smokestack. The air that is sent under the grate bars is to supply additional oxygen to the coal and, though not acting as a powerful draft creates thereby greater combustion.

One of the greatest drawbacks to a low grade of lignite coal is that when used in the ordinary engine, a large percentage of fine coal is sent out of the smokestack in a shower of sparks. This makes it difficult to keep up steam when the engine is working hard. Lignite is also slow at starting. The McKenna blower, it is thought, will eliminate the loss of coal, when running through the weakening of the induction draft while the turbines will aid combustion through the supplying of plenty of air. Two or three trials have been given the blower, but as yet it has not been tried sufficiently for any definite announcement to be made. Only one kind of coal has been used so far. The new blower has shown so far that it works favorably when the engine is at a standstill and will thus facilitate the keeping up of steam. The tests are being watched with interest by coal men since, if successful, it will solve the problem of lignite and slack coal for railroad purposes. J. W. PERCY.

Tacoma, Wash.



FACING TOOL FOR E. T. VALVE.

Facing Tool for Distributing Valve E-T Equipment.

Editor:

Attached print shows hand tool that is used as facing tool for distributing valve on E-T air brake equipment. The object of this tool is to relieve the shoulder which forms at end of valve travel, and also lower the seat beyond valve travel so that shoulder can not form. This bushing is 6 ins. long and valve travel is about 2 ins., and by using this tool it dispenses with the filing and scraping of this extra 4 ins. of difficult seat to get at. The tool holder is turned slip fit in bushing and has flat tool in end which is adjusted to its work by eccentric head screw in end of tool holder, and is forced through bushing by ⅝ in. screw and yoke across end of distributing valve.

CHAS. MARKEL,
Shop Foreman, C. & N. W. Ry.
Clinton, Iowa.

Broken Rails.

EDITOR:

As usual, when a few fast trains go off the track, everyone says that the speed is too great. Then great praise is given to the steel cars which saved so many lives. As a matter of fact, the steel cars often have caused the wrecks. Their weight of 80 to 90 tons requires more powerful and consequently heavier engines. Thus the weight of locomotives is 75 per cent. greater and worse, the axle load has also increased. The heavier reciprocating parts and counterbalances makes a greater pound on the rails, since no two cylinder engines can be perfectly balanced. The length of a 4-6-2 engine when swaying also puts severe stresses on the track, tending to spread or to break the rail.

Fifteen years ago the trains on many of our Eastern railroads ran just as fast as today. There were about as many wrecks, but few were caused by broken rails. They were due to disregard of signals and resulted in collision. Today the wrecks are caused mostly by broken rails, and by the breakage of running

parts such as wheels and axles. The twelve-wheeled Pullman of 1895 were about 70 ft. long and weighed 50 tons. The day coaches weighed from 35 to 40 tons. Nearly all the express trains on level roads were hauled by 4-4-0 engines. carried as many passengers as today and made the same speed. The rails used were 85 to 90 lbs. per yard. It might be here said, that the size of rails has not increased in proportion with the

GRAND TRUNK PASSENGER TRAIN.

rolling stock. In England the standard 70-ft. twelve-wheeled car weighs 35 tons. On many roads the work is still done by 4-4-0 engines. Why cannot we build cars of about that weight and use 4-4-0 engines? With the modern improvements, such as superheaters, piston valves and the Walschaert gear, they should do even better work than they did fifteen years ago. Besides the lessening of accidents, it would be a great saving of power to reduce the weight of cars more than one-half and have the same carrying capacity. I suppose that some people will say that light cars would not ride well or would not even stay on the track. They ride very well in England and stay on the track, and many of our roads have tracks as good as that in England.

What I have said may seem ignorant and unscientific, but is it not logical to say that, if lighter axle loads and lighter

G. T. PASSENGER TRAIN.

rolling stock were used on 100-lb. rails, the liability to break (even in weak spots) would be reduced to a minumum? Thus, if the breaking of rails could be stopped, the only chance left for accident on a block system road would be running by danger signals, and I suppose the only thing to cure that is an automatic stopping device which would work under all weather conditions.

WM. LANDON.

New York, N. Y.

Grand Trunk Passenger Trains.

Editor:

Enclosed are some snapshot photographs of the Grand Trunk Railway passenger trains passing in this vicinity. The trains were running at about forty-five miles an hour, and the photographs were taken in the two-hundreth part of a second. In the clear air of the North it seems to me that we can take better photographs than some of the interesting views that you reproduce from other parts of the country, but all of your illustrations are of much interest. Some of them are appearing on post cards here and are very popular among others besides railway men. I would be pleased to hear from any of your readers who would like to possess a selection from my extensive stock of photographs of locomotives.

E. L. GREEN.

South Paris, Me.

THERMIT WELD ON A MALLET.

Hand Signal Disks.

Editor:

The length of trains now are such that it is often difficult to distinguish the signals to proceed or back up as directed by the conductor or flagman, and it has occurred to me that what may be called a hand signal disk consisting of a circular shaped metal plate painted white on one side and vermilion on the other, would be an improvement on the present method of signaling. They could be readily kept clean and would in all kinds of weather be seen further and better than the faded flags now in use. These disks could have projecting handles attached, suitable for holding, like a fan. They would be impervious to the weather, and would in any case be preferable to the waving of arms and hands that are not infrequently misleading even at short range, and in going back to signal another train the disks would under any condition be an improvement on the present system.

J. J. PRATT.

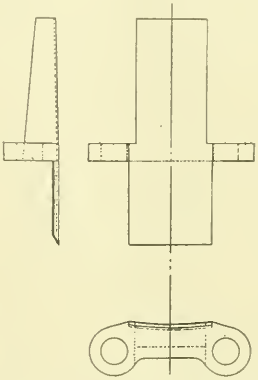
Paterson, N. J.

Entering Pistons and Welding Frames.

Editor:

Enclosed are photograph and drawings of a device for entering pistons in cylinders, and which is being very successfully used here, especially on the larger class of locomotives where the cylinder rings are not so easily collapsed as are the smaller variety. As the illustrations show the details of the device no lengthy description is necessary.

Enclosed is also a photograph of a



DETAILS OF DEVICE FOR ENTERING PISTONS IN LOW PRESSURE MALLETS.

Thermit weld made on the front bottom boiler rest and frame cross-tie on a Mallet compound locomotive, and which effected a saving of $300 by so doing. The very successful weld was made under the direction of Mr. R. L. Woodman, our foreman blacksmith.

ED. MURRAY, M. M.,
C. & O. Ry.

Clifton Forge, Va.

Theory of the Injector.

Editor:

The apparenty paradoxical action of the injector by which steam from the boiler forces water against its own

CYLINDER WITH CLAMPS ATTACHED.

pressure is explained by Robert Grimshaw, an eminent authority, as a question of velocity not of pressure. At a given pressure steam escaping from an orifice has a higher velocity, say 2,000 ft. per minute, than water under the same pressure, say 150 feet. In issuing from the injector nozzle the steam strikes the water that also enters the combining-tube, condenser and at the same time imparts to the feed-water together with the con-

denser, its own velocity thus driving it into the delivery-tube, and as this feed water has a higher velocity than water would have under the given steam pressure in issuing from the boiler it can overcome the pipe friction, raise the check valve and enter the boiler against the latter's pressure.

The continual condensation of the steam causes a vacuum to fill, which new water rushes in from the feed. There is also another element entering into the explanation of the injector's action which has not been accorded the prominence which it deserves, viz., atmospheric pressure, and this may best be explained in this manner. Suppose that the steam pressure on the boiler is 200 pounds per square inch, then all pressure to work the injector must be the same so long as the supply is drawn from the same boiler into which the water is to be injected. How 200 pounds may be used to force against 200 pounds has been explained. but the part omitted is that the water in the tank is always under the atmospheric pressure of 14.7 pounds per square inch, or as generally termed 15 pounds, so the proposition is really one of 215 pounds against 200 pounds. This has more to do with the action of the injector than is generally credited. As a proof, I can recall a number of instances when in severe winter weather the best injectors would not work at all, and after a lengthy examination it was found that the manhole cover on the tank was frozen down. This deprived the injector of the weight of the atmospheric pressure, and it was noted in every case that after the cover had been thawed out it went to work without trouble. I believe that a large measure of the success pertaining to the operation of injectors is due to the fact that its functions are thus supplemented by the pressure of the atmosphere. I was told by the instructor of the class after giving my opinion as to the working of injectors that my views were very good, but if I would study the question closer I would find out that I was mistaken in some of my views. I should be pleased to hear from some of the readers of RAILWAY AND LOCOMOTIVE ENGINEERING, and if they will point out to me my mistakes, as I have studied the injector very closely, and would be obliged to any one for better enlightenment.

Covington, Ky. L. C. BRICKHOUSE.

It is observable, especially among railway men, that the importance of economy is being more carefully considered than heretofore. The tendency of modern steam engineers is to capture part of the vast heat losses constantly passing away in the exhaust steam. The practice is represented by the aphorism, "A heat unit saved from the exhaust is worth two in the coal pile."

Superheaters in Great Britain.

The majority of British companies are adopting the Schmidt type of superheater, says the London *Times*, and there are now about 260 locomotives so fitted and another 140 under construction. It is stated that the London and North-Western Company will shortly have 100 Schmidt superheated locomotives in service. One point which, with this type, requires very careful attention is the design of cylinder and piston valves, and, of course, special attention has to be paid to the lubrication problem; the usual practice is to fit mechanical lubrication, the oil being discharged under pressure by means of a small pump worked off the engine. Mr. Bowen Cooke has issued no recent statement as to the economies following the adoption of superheating, but the fact that it is being so largely adopted makes it certain that the claims made in its favor are being realized in practice. The London and North-Western has also adopted feed-water heating in conjunction with superheating. The engines which have been fitted are of the "George the Fifth" and the "Experiment" classes, the latter being intended for service on the Crewe-Carlisle section. An announcement as to the results achieved may be looked for at an early date.

The Lancashire and Yorkshire has now 52 Schmidt superheated locomotives in service, and 20 other engines are ordered to be similarly fitted. Another line upon which a considerable number of superheated engines are in operation is the Great Northern. Here again the Schmidt type has been largely adopted, the latest figures showing 50 engines in service and 20 in process of being equipped. It is understood that the experience gained with the new superheated "Atlantics" has been very satisfactory. The Great Northern Company is also giving a trial to the Robinson tube superheater.

The London, Brighton, and South Coast Company has now in service 22 engines fitted with the Schmidt, but is also experimenting with a smoke-box superheater as well as with a new type of feed-water heater.

The Midland Railway was somewhat slow in adopting superheating owing to the fact that reliance was largely placed on the compound engine where the advantages following superheating represent a lower percentage of economy. Mr. Henry Fowler, the chief mechanical engineer, has, however, ceased to build new compounds, but is reconstructing a number of locomotives with the intention of fitting the Schmidt superheater. A few are indeed now in service. The latest stage of the work at Derby is the institution of comparative tests between the Swindon and the Schmidt types on two of the new goods engines. The Great Eastern Railway is also carrying out comparative tests of the Swindon and Schmidt types, while the latest convert to superheating, the South-Eastern and Chatham Railway, has just fitted a Schmidt superheater and piston valves to one of the latest types of passenger engines, and trials are at present in progress.

The North-Eastern Company, one of those which is stated to be experimenting with the Robinson, has also ten locomotives fitted with the Schmidt. The results of superheating in service have been so satisfactory that all new engines are being designed as superheaters, and all engines coming in for shop repairs are being converted. The North Staffordshire Company has carried out comparative trials with four superheater engines and is now adopting the principle for others.

SCOTTISH AND IRISH RAILWAYS.

The North British has two Schmidt engines, and has also fitted a 4-4-0 passenger locomotive, cylinders 19 ins. by 26 ins., with the Phœnix smoke-box superheater, but the latter has not been in service a sufficient length of time to enable statistics to be published. The Caledonian Company is extending the employment of superheated steam on the Schmidt system, and while only ten engines are now equipped, Mr. McIntosh hopes to have 22 at work in May next. It has been decided to fit all new engines as well as all those specified to have new cylinders.

The Glasgow and South Western Company has had two engines built and equipped with the Schmidt design, and has been carrying out careful tests against non-superheater engines on the Glasgow-Carlisle section. The gains following the adoption of superheating are stated at 18¼ per cent. of coal and 20 per cent. of water.

The Irish railways which are experimenting with superheating include the Great Northern, which has ordered ten engines to be equipped, the Great Southern and Western, which has one in service, and is about to have another fitted with the Schmidt, and the County Donegal, which has three engines with the Schmidt apparatus in service.

How Railroad Men Are Made.

The *Scientific American*, of February 17, last, has an admirable article by Mr. P. Harvey Middleton on the above subject, which is worthy of the perusal of railway men, especially the younger element. The article traces very clearly the great improvement that has taken place in the better education of the young railway men and their opportunities to rise in their calling.

Pacific Type of Locomotive for the Chicago and Eastern Illinois

The Baldwin Locomotive Works has recently built eight Pacific type locomotives for the Chicago & Eastern Illinois Railroad. These locomotives use superheated steam, and develop a tractive force of 41,200 lbs. With 165,150 lbs. on driving wheels, the ratio of adhesion is 4.02. This ratio is in accord with approved practice for superheater locomotives, and the tractive force is sufficient for heavy service. The heating surface of the superheater is 825 sq. ft., and considering each sq. ft. of superheating surface as equivalent to 1½ sq. ft. of water evaporating surface, the total equivalent heating surface is 4,887 sq. ft., or 274 sq. ft. per cu. ft. of cylinder volume. The weight on driving wheels is 33.8 lbs. per sq. ft. of equivalent heating surface. These ratios indicate a relatively powerful boiler, which, especially in fast passenger service, is essential to successful locomotive performance.

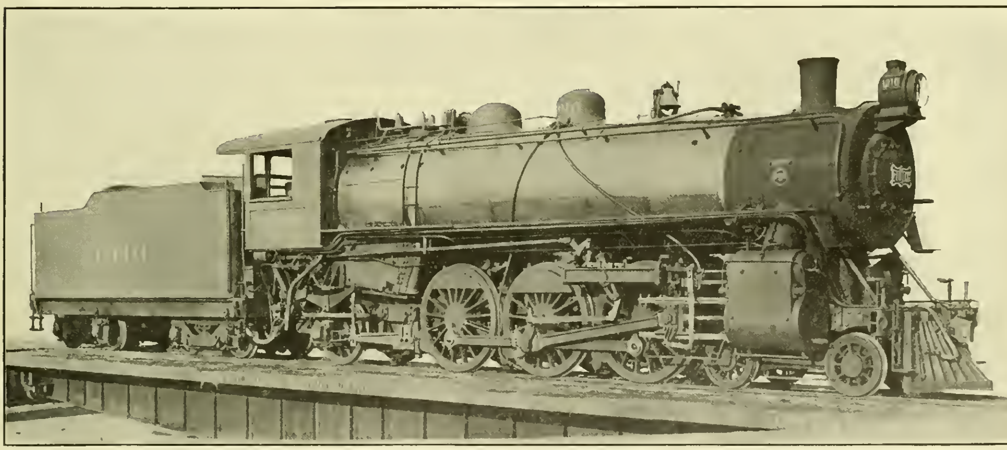
The boiler barrel is composed of three rings, the first of which is tapered. This increases the diameter from 76 ins. at the front end, to 85½ ins. at the dome ring The longitudinal seams are on the top center line. They are sextuple riveted and welded at the ends, in accordance with the regular practice of the builders. The feed enters the boiler on the top center line, 20 ins. back of the front tube sheet. Due attention has been given to making provision for free circulation. The tubes are spaced with ⅞-in. bridges; while the water spaces are 4½ ins. wide all around, increasing in width, at the top, to 7⅜ ins. in the side water legs, and 8 ins. in the back water leg. The throat has a depth of 25½ ins., measured from the under side of the barrel to the bottom of the mud-ring. The flexible stay bolts number 537. These stay the entire throat, and are used in the four front rows of crown stays, replacing the T-irons and expansion links commonly employed at this point. The remaining flexible bolts are used in the three upper transverse rows and two outside vertical rows in the back head; and in the three upper horizontal rows, and two outside vertical rows at the front and back in the side sheets.

Provision is made for suppressing smoke by means of steam jets, three of which can be discharged into the furnace on each side. The nozzles are placed in 2-in. tubes. The grate is of moderate width for a locomotive of this size, and the side water legs slope outward as they rise. The furnace contains a brick arch, supported on water tubes.

The superheater is of the Schmidt type with 32 elements, and the superheated steam is conveyed to the steam chests through outside steam pipes. The steam distribution is controlled by 13-in. piston valves, which are driven by Walschaerts gear and are set with a lead of 3/16 in. The cylinder barrels are bushed. The valve stem crosshead slides on a guide which is bolted, in front, to a lug cast on the back steam chest head, and at the back to the guide bearer. The cylinders are fitted with by-pass valves of the Sheedy type.

The frames are 5 ins. wide and 7 ins. deep over the pedestals. Each frame is made in two sections, the splice being located back of the rear drivers. A very substantial system of frame bracing is applied to this locomotive. The guide yoke is bolted to a broad steel casting, which spans the upper rails just ahead of the leading driving pedestals. Between the first and second pairs of drivers is a similar casting, which supports the brake cylinders and valve motion crosstie. Between the main and rear pairs of drivers is a third broad tie, and to this a waist sheet is bolted. Deep braces are also bolted to the main and rear driving pedestals. The rear pedestal brace is extended back over the splice between the main and rear frame sections, and to it is bolted an expansion plate, which supports the front end of the firebox. A similar plate supports the firebox at the rear, and is bolted to the foot-plate.

The longitudinal sills of the tender frame are composed of 13 in. channels weighing 40 lbs. per ft.; while the bumpers are of cast steel. The tender wheels are of forged and rolled steel, and were manufactured by the Standard Steel Works Company; as were also the front engine truck wheels.



4-6-2 TYPE LOCOMOTIVE FOR THE CHICAGO AND EASTERN ILLINOIS RAILROAD.
S. T. Park, Superintendent of Motive Power. Baldwin Locomotive Works, Builders.

The following are the principal dimensions of these locomotives.

Gauge, 4 ft. 8½ ins.; cylinders, 26½ by 28 ins.; valves, balanced piston.

Boiler—Type, wagon top; material, steel; diameter, 76 ins.; thickness of sheets, 23/32 and ¾ in.; working pressure, 180 lbs.; fuel, soft coal; staying, radial.

Fire Box—Material, steel; length, 108⅛ ins.; width, 60¼ ins.; depth, front, 86¼ ins.; depth, back, 73¼ ins.; thickness of sheets, sides, ⅜ in.; thickness of sheets, back, ⅜ in.; thickness of sheets, crown, ⅜ in.; thickness of sheets, tube, ½ in.

Water Space—Front, 4½ ins.; sides, 4½ ins.; back, 4½ ins.

Tubes—Diameter, 5½ ins. and 2¼ ins.; material, steel; thickness, 5½ ins.; No. 9 W. G.; 2¼ ins. No. 10 W. G.; number, 5½ ins., 32; 2¼ ins., 199; length, 21 ft. 0 in.

Heating Surface—Fire box, 208 sq. ft.; tubes, 3,413 sq. ft.; firebrick tubes, 28 sq. ft.; total, 3,469 sq. ft.; grate area, 45 sq. ft.

Driving Wheels—Diameter, outside, 73 ins.; diameter, center, 66 ins.; journals, main, 11 ins. by 12 ins.; journals, others, 10½ ins. by 12 ins.

Engine Truck Wheels — Diameter, front, 33 ins.; journals, 6½ ins. by 12 ins.; diameter, back, 49 ins.; journals, 8½ ins. by 14 ins.

Wheel Base—Driving, 13 ft. 0 in.; rigid, 13 ft. 0 in.; total engine, 34 ft. 8 ins.; total engine and tender, 67 ft. 4 ins.

Weight—On driving wheels, 165,150 lbs.; on truck, front, 53,550 lbs.; on truck, back, 42,900 lbs.; total engine, 261,600 lbs.; total engine and tender, about 425,000 lbs.

Tender—Wheels, number, 8; wheels, diameter, 34 ins.; journals, 5½ ins. by 10 ins.; tank capacity, 9,000 gals.; fuel capacity, 14 tons; service, passenger.

Engine equipped with Schmidt superheater. Superheating surface 825 sq. ft. (steam side).

Crucible Steel Industry of India.

The industry is carried on at a small village called Venkatanaikanpaln, about two miles from Parvankmicht, occupying a favorable situation for obtaining charcoal from the surrounding hills of the Marnngapuei Zeninadaei. It affords employment for about sixteen families of Smiths, and is altogether in the hands of a Mussulman named Mahonud Routhen, who holds a monopoly of the right to make charcoal for the purpose in the jungles of the estate, for which he pays 1,000 rupees per annum. Beyond the convenience of its situation, as regards the jungles and the existence of tolerably fine red earth in the vicinity, the site possesses no special advantages. The process employed is very simple. Small quantities of iron are enclosed in a small earthern crucible with a few pieces of wood of the aoaram plant and two or three green leaves. A top is luted on, and when dry, the whole is exposed to the heat of a small charcoal furnace till the iron is melted, a fact which the operator ascertains by picking up the crucibles in a long pincer and shaking them. The vessels are allowed to cool and are then broken open, when a knob of steel is found at the bottom.

Two sizes of ingots are made, weighing about 8 oz. and 16⅔ oz. respectively. The crucibles consist of a mixture of red earth and charcoal, made of paddy husks kneaded together. They are shaped on a wooden plug about 5 ins. long and 2 ins. in diameter for the smaller size of ingot and slightly larger for the other size, having a conical end which forms the bottom of the cavity in which the steel collects while fluid. The lid is of the same material and put on net. It appears hardly to contract at all in drying and a fairly air-tight vessel is consequently produced. The clay is not nearly refractory enough for the heat it is exposed to, so the crucibles are completely antrophied and spoiled at the end of a single operation. The iron used is brought from the Namskal of Salem and appears to be a rough description of wrought iron. For the smaller size of ingots it is cut into pieces weighing as nearly as possible 10 oz. (a small piece is added to make up the weight if necessary), and this quantity is placed in each crucible with 3¼-oz. weight of piece of dry wood of the avarum plant, two or three green leaves (the kind is a matter of no consequence), are placed on the top and the charge is closed up with a lump of clay, carefully plastered all around. Great care is taken in putting in the correct proportions of iron and avarum wood, and the operators assert that if less is used the iron is not melted, and if more, it will not stand being worked afterwards. The green leaves probably serve in some way towards retarding the drying of the lid and preventing it from cracking. The furnace consists of an inverted cone of earthwork about 2 ft. in diameter and the same in depth, the apex opening into an ash pit below. At one side and protected from the heat by a mud wall, is a small shed in which two bellows men sit and work a couple of skin bellows most vigorously. The air is admitted into this furnace through a hole near the bottom. In preparing a furnace, some straw is first placed at the bottom, below the air hole, and charcoal is then thrown in to a suitable height. On this twenty-five of these conical crucibles are placed with the point downward, and when all are in position they appear to form a sort of circle, and to be independent of the layer of charcoal below. More charcoal is placed above, and the furnace is then lighted through the air hole. Fresh fuel is thrown on above from time to time and one or two of the crucibles are occasionally lifted with long-handled pincers to allow the burning charcoal to fall through and replenish the supply below. The steam remains untouched by the fire throughout the process. The crucibles are given a sharp shake on these occasions, which is said to assist the process and towards its conclusion allows of the operators ascertaining whether the iron is melted. As the mouth of the furnace is open, the waste of fuel is enormous and not one-fourth of the charcoal used exercises any effect on the crucibles. In the absence of good fire clay this fault seems irremediable, as there is no sufficiently refractory material available from which a separate opening for the supply of charcoal to the furnace below could be constructed. After about an hour or an hour and a half, the fuel of a crucible, when lifted, shows its contents to be liquid. The process is then considered to be completed and the crucibles are allowed to cool, after which they are broken open, a knob of steel being found at the bottom of each. The ingots are reheated and hammered into oblong pieces, in which shape they are sold. All crucibles do not remain absolutely air-tight during the process, the lids becoming cracked without affecting the result. The collector had the contents of one of these poured out through a crack, and was surprised to find the steel in a state of extreme fluidity, a thing which the heat produced.

Laws Regarding Trespass of Stock.

Railway people in the United States nearly all believe that the common law of England, which holds good in most of our States, requires that the owners of cattle prevent their stock from trespassing upon other people's property. That this is a mistaken expression has recently been pointed out by our Glasgow agent, A. F. Sinclair, who is a regular contributor to the *Glasgow Herald*. Mr. Sinclair writes:

"It is to be feared that we shall have to revise our ideas regarding the responsibility of people who allow horses and cattle to stray on to the public roads. It is the general impression, perhaps because it is commonsense, that the owner of such animals is responsible in law for any damage resulting from their presence on the highway should they have strayed from any adjoining field. That is to say, a farmer would, on the surface of things, seem bound to keep his fences in such repair that animals could not thus stray, or if they did so it would be at his risk.

"From a judgment of the King's Bench Division of the English High Court many of us will learn for the first time that there is no obligation in law on the farmer or the land owner to fence his fields. The decision was reached in an action by two cyclists who, while riding a tandem ran into a horse, a collision by which one of the two was severely injured, while the tandem was wrecked. The County Court Judge admitted that the cyclists had been riding with care and that the farmer had been negligent, but he found himself bound nevertheless to decide in the latter's favor. And the King's Bench Judges have not only endorsed his decision, but have refused the cyclists' application for permission to appeal. I suppose that the total absence of fences in many parts of Scotland, especially in sheep raising districts, might have prepared us for such a judgment, but somehow it had been the practice to regard that condition of things

as a mere evasion of the law, winked at by the authorities on account of the poverty of the land. But now we learn from the King's Bench that "by common law the owner or occupier of land adjoining a highway is under no duty to fence so as to keep his animals off the highway," and "assuming that the owner of this horse had been guilty of negligence they (the plaintiffs) would have to show that the horse was one which, to its owner's knowledge, was likely to cause the particular damage complained of." The learned judge who delivered judgment also said that he had expected the plaintiffs' counsel to plead some statute law on the subject—he mentioned the Highway Act—and from the lawyer's inability to quote such an Act it is justifiable to assume that none exists."

Mechanics of the Heart.

The ordinary man's heart is a pumping station which beats or pumps about seventy-two times a minute, says *Good Health*. When he was a baby it beat about one hundred and twenty strokes to the minute, and when he is sixty years of age he will, if he takes out his watch, find that his heart is pumping in time to the seconds—sixty strokes to a minute. A normal heart pumps about six ounces of blood at every beat, or four hundred and thirty ounces each minute. This means that this little pump lifts every six or seven minutes a weight equal to that of his own body. Stimulants, insufficient sleep, enervating emotions, and occupations that are deleterious and require great expenditure of nervous energy, will result in functional disorders of the heart, and if persisted in the disturbance will eventually become organic. As the heart rests between the beats, anything which causes it to beat from five to ten additional strokes per minute continually will rob it of its needed rest. The more work demanded of the heart during the day, the more sleep is needed to compensate for the added strain. The heart beats about ten times a minute less while lying down, and during sleep, than while standing and working, so that in one hour six hundred strokes are thereby saved. In eight hours, or during a night's sleep, forty-eight hundred beats are saved, and if the heart pumps six ounces of blood at each stroke it would save in labor the pumping of twenty-eight thousand eight hundred ounces or eighteen hundred pounds during the night. The heart is a faithful little pump and a good servant. Treat it well and it will perform its work uncomplainingly. Give it a vacation occasionally and your consideration will be repaid with interest; but overwork it by the whip of stimulants and long hours, make it a slave instead of a servant, and, though it will not complain much, it will work harder and harder until it wears out, and finally demands your life as a forfeit.

Preservation of Timber.

The deterioration of timber by preventable decay causes a heavy demand upon the timber resources of the country. In 1910 about 126,000,000 cross ties were purchased to make renewals. By the adoption of devices to retard wear and methods to prevent decay, however, the present trackage could probably be maintained with nearly one-half the quantity of wood at present consumed annually for this purpose.

Among the chief causes of the deterioration of cross-ties are decay, insect attack, splitting and respiking. By treatment of ties, and the use of improved fastenings, a mechanical life probably more than twice as long as that of the average untreated ties could be secured. The treatment of ties to prevent decay always results in a very great saving to the railroads. The preservatives used are mostly creosote oil or a solution of zinc chloride. Sometimes a mixture of both proves very effective. Crude petroleum is also used in some districts, while there are a number of methods in use with other liquid compounds, and all add to the durability of the timber treated.

Y. M. C. A. Rooms on the Erie.

As a rule the Railroad Department of the Young Men's Christian Association perform a noble work for railroad men, a work that deserves more encouragement than it receives. We have particularly good opportunities of noting the work done by these people on the Erie Railroad and are full of admiration for the sustaining and uplifting influence they exercise upon railroad employees, especially train men.

It will hardly be considered invidious if we make special mention of the work done by Mr. Charles H. Turner at Port Jervis, who has for years labored under the disadvantage of having inferior rooms. This defect will soon be surmounted, for certain generous persons have supplied the means for putting up a new building at a cost of $40,000. We understand that Mr. F. D. Underwood, president of the Erie, led in the contribution with $10,000 and that Mrs. Harriman donated a like amount.

Electric Railways for Russia.

Russia is to adopt electric traction on a number of sections of railroad, especially in the district around St. Petersburg. The conditions are favorable for carrying this out, for a good supply of water power for operating electric stations can be secured from the falls of the Volkhoff river in the Novgorod region.

The World's Railway Mileage.

The following statistics, relating to countries where the railway mileage exceeds 1,000, are copied from a report recently published in the Bulletin of the International Railway Congress Association. The particulars are the latest for which complete information is avaliable.

	Miles.
United States	237,182
Germany	37,338
Russia (Europe, including Finland)	36,912
British India	31,483
France	30,186
Austria-Hungary	27,165
Canada	24,099
Great Britian and Ireland	23,286
Argentine Republic	15,850
Mexico	15,013
United States of Brazil	12,997
Italy	10,438
Spain	9,293
South African Union	8,939
Sweden	8,573
Siberia and Manchuria	6,423
Japan and Corea	5,767
Belgium	5,144
China	5,296
Russia in Asia	4,066
Queensland	3,843
New South Wales	3,763
Egypt	3,503
Victoria	3,435
Algiers and Tunis	3,134
Asia Minor, Syria, Arabia and Cyprus	3,129
Chili	3,290
Switzerland	2,845
New Zealand	2,681
Cuba	2,328
Western Australia	2,321
Netherlands and Luxemberg	2,244
Denmark	2,165
Roumania	2,085
Turkey in Europe and Bulgaria	2,052
Norway	1,865
Portugal	1,798
Dutch India (Java, Sumatra)	1,537
Peru	1,470
Other African lines (German)	1,469
" " " (British)	1,264
" " " (French)	1,261
Uruguay	1,446
Grand total	625,578

Cost of Stopping Trains.

The cost of stopping a train of 530 tons and returning to a speed of fifty miles an hour is 42 cents. The cost of stopping a 2,000-ton train from thirty-five miles an hour is $1. Other reports on the same subject estimate each stop of a six-car passenger train from forty-five miles an hour at 35 cents and for a 1,500-ton train from fifteen miles an hour at 56 cents. The time lost for making a stop on a straight level track is estimated at 145 seconds.

New 4-6-0 Express Engine, Great Eastern Railway of England.

A powerful express engine of the 4-6-0 type has recently been put into service on the Great Eastern Railway, built at Strafford Works from the designs of Mr. S. D. Holden, the locomotive superintendent. It is fitted with the Schmidt superheater and has the following leading dimensions: Boiler length, 12 ft. 6 ins.; boiler diameter, 5 ft.; steam pressure, 180 lbs. per sq in.; heating surface: tubes, 1489.1 sq. ft.; superheater, 286.4 sq. ft.; firebox, 143.5 sq. ft.; total, 1919.0 sq. ft.; grate area, 26.5 sq. ft.

The cylinders, 20 ins. diameter by 28 ins. stroke, are placed horizontally between the frames, and the piston valves are fitted with their centers vertically above the cylinder centers. These piston valves are 10 ins. in diameter, with inside admission, 1⅛ ins. lap and 3/16 in. exhaust negative lap, and are operated by a Stephenson link motion through the medium of a rocking shaft. The connecting rod is 7 ft. 3 ins. long and of I section. The leading dimensions are as follows:

Diameter of coupled wheels, 6 ft. 6 ins.; diameter of bogie wheels, 3 ft. 3 ins.; diameter of tender wheels, 4 ft. 1 in.; wheelbase of engine and tender, 48 ft. 3 ins.; length over the buffers, 57 ft. 7 ins.; weight in working order, engine, 64 tons; tender, 39 tons 5 cwt.; total, 103 tons 5 cwt.

equal to hauling one ton almost 220,000,000,000 miles.

The 46,000 passenger cars of the railroads of the United States, valued at $300,000,000, are capable of seating at one time 2,300,000 people, and, if pressed for room, would accommodate probably 3,500,000 persons. They transport annually almost 900,000,000 passengers, each of whom ride approximately thirty-three miles. Practically, therefore, one passenger is hauled 30,000,000,000 miles.

There are 57,000 locomotives doing service for the railroads of this country, 47,000 of which are used to transport people and wares. The total number is estimated to be worth no less than $1,000,000,000. The freight and passenger locomotives alone cover 8,500,000 miles in a single year. The engines consume annually fuel and water enough to cost the public carriers of the country $218,000,000, the effect of the distribution of which is felt in every nook and corner of the land.

Yet the owners of these vast facilities, rendering so tremendous a service to the people of the country, received for the year ending June 30, 1909, only $236,000,000 in dividends on a total capitalization of $14,000,000,000.

The trackage of the United States, 350,000 miles, would build a railroad from the earth to the moon, and

Practically 900,000,000 ties, 7,650,000 feet long, receive these spikes.

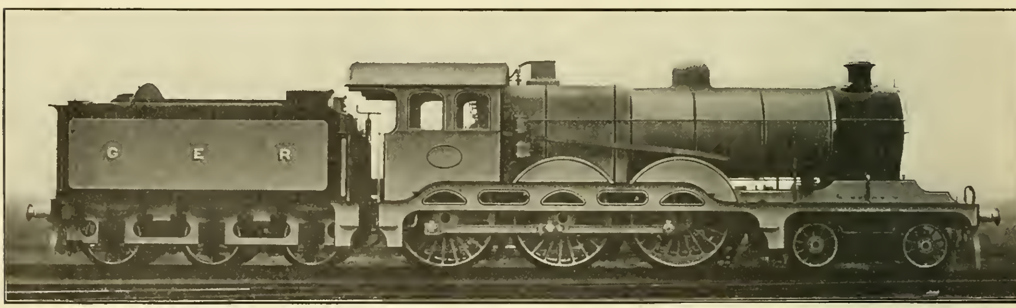
To transport each passenger, the railroads move four and a half tons of equipment or dead weight, useful only in making it possible to carry a passenger in safety and comfort.

For each family in the United States the railroads ship seventy-five tons annually; this is equal to one ton being shipped a total distance of 11,325 miles.

Each inhabitant of the United States takes approximately ten trips on the railroads yearly of thirty-three miles each. The cost of this service is only one and seven-tenths cents per day per capita.

A Good Example.

The superintendent of the Long Island Railroad has just issued an order requiring conductors, trainmen and station agents to make every effort to ascertain the cause of any sudden interruption of train service, and answer freely and courteously all questions addressed to them upon this subject by passengers or others about to travel. Station agents will also endeavor to find out why trains are late and see that prospective passengers waiting at the stations are properly advised. The dispatcher's office will also try to get in touch with the agents and assist them in ascertaining the cause and extent of the trouble.



TEN WHEEL LOCOMOTIVE FOR THE GREAT EASTERN RAILWAY OF ENGLAND.

A Gigantic Industry.

A recent issue of *The Bankers' Magazine* has an exhaustive article which finely illustrates the gigantic proportions to which the railroads of the United States have grown and from which we make the following extracts:

The 2,100,000 freight cars of the railroads of the United States, valued at $2,500,000,000, and capable of holding 147,000,000,000 lbs. at a time, are sufficient to form a single train around the earth at the latitude of Chicago. In them are hauled annually over 1,500,000,000 tons of freight, each ton of which is carried 151 miles. This is

100,000 miles beyond, or 133 transcontinental railroads. The rails of the 350,000 miles of our tracks weigh approximately 43,000,000 tons, and would counterbalance the weight of three-fourths of the people of the earth. There are enough to form eighty-two steel roads with which to skewer the earth.

To hold the rails to the ties, in round numbers, thirty times as many spikes are necessary, 300,000,000, as the number of stars which even the keen lens and the sensitive film of the camera have been able to reveal. The cost of these spikes alone is approximately $30,000,000.

Convention of Tool Foremen's Association.

The next annual convention of the American Railway Tool Foremen's Association will be held in Chicago, Ill., July 9, 1912, at which time the following topics will be taken up: Standardization of Steel for Small Tools; Milling Cutters, Their Formation, Tempering, etc.; Care of Shop Tools; Checking Systems; Treating Steel in Electric Furnaces. This association is in its third year and those eligible to membership are foremen in charge of the tool rooms in steam and electric railway shops. The membership is rapidly increasing.

General Foremen's Department

Forced Feed Lubrication of Driving Boxes.

When any part of railroad machinery has worked in service so that it gave little trouble, the tendency has always been to perpetuate its use without attempts at improvement. When the first practical locomotive ever run in this country was put to work eighty years ago, it had a certain form of axle box that was oiled by pouring the lubricant into a crude recess on the top, and that method of lubrication has been continued to the present day, not because it was efficient, but because it gave no particular trouble. We wonder if motive power men have ever thought of investigating the amount of waste of power and of unnecessary wear that has resulted from the inefficient manner in which these axle boxes have been lubricated.

Parties interested in promoting a mechanically forced lubricator have been applying their devices to locomotives recently, and the results have been astonishing and ought to serve as an object lesson to all the motive power men in the country. The report of one inspector reads: "Engine shopped last January on account of flues. One side made one hundred and fifty-five thousand miles. One side had broken valve last fall, not fault of lubricator. Cylinders and bushings not bored. Drivers were not dropped. Journals and brasses not touched since engine was built."

Think of that. An engine was run one hundred and fifty-five thousand miles and the axle box brasses were found to be in such good shape that the drivers were not dropped. And this extraordinary performance was entirely due to the use of an apparatus that kept a constant supply of oil moistening the journals.

The saving of wear is no small consideration, but the saving of coal due to the reduction of friction must have run into hundreds of dollars.

We are privileged to give the following particulars of the discoveries that brought about the invention of the forced feel lubricator.

A forced feed lubricator will convey the idea that the bearing must be incased in a hermetically sealed casing.

It will also bring to mind a waste of oil. Ordinarily both of these assertions would be true, but the necessity of a hermetically sealed casing or waste of oil have both been abolished by a new and scientific method of lubrication.

On the subject of lubrication the hydraulic bearing used under turbine wheels in Switzerland contains more science and moral teaching than all the books on the subject of bearing and lubrication put together.

The germ of invention for the elimination of "hot boxes" must originate by studying this wonderful hydraulic bearing. It does not use a drop of oil and it sustains hundreds of tons at most terrific speeds, and there is no case on record when one of these bearings became warm or had worn out. Let us examine it! Every railroad official should know all about it.

Switzerland is a country of waterfalls, and incidentally one of turbine wheels. The Swiss engineers used to have a gay old time with "hot boxes" on their old-style horizontal turbine wheels. The vertical shaft, the horizontal turbine wheel and the great weight of a column of water thereon were all supported by one bearing, made of hardened steel, situated at the bottom of the vertical shaft. This bearing, although submerged in water, had a mania to run hot constantly, and thereby vexing and disgusting everybody connected with it.

In building horizontal Swiss turbines the limit in sizes was soon reached on account of excessively hot bearings. Something had to be done to relieve the desperate situation and something was done: The hydraulic bearing was invented.

The hydraulic bearing consists of a perforated horizontal iron bed plate imbedded in the foundation and on an even level therewith. Its diameter is generally about six feet. When the water is turned on, a multitude of vertical jets shoot out of the perforations from below upward, and this constitutes one-half of the bearing. The other half is affixed on the bottom of the vertical shaft of the turbine and it merely consists of a stout and smooth horizontal plate facing downward and of about six feet in diameter. When the turbine is standing still the horizontal plate of the vertical shaft rests on the perforated foundation or bed plate.

The water to drive the turbine is tapped from a reservoir at a slightly lower level, and the water for the "hydraulic bearing" is tapped from a reservoir at a higher level, giving the latter a greater pressure.

When the turbine is running, the revolving plate on the vertical shaft is *never* in actual contact with the stationary bed plate. There is always a thin film of water between the two plates, which is under a pressure sufficient to lift the entire weight of the shaft, turbine and column of water thereon, which at times weighs several hundred tons.

A hydraulic bearing will run for a decade *absolutely without wear.* The bearing surfaces do not even wear the rust off from each other.

The hydraulic bearing demonstrates the fact that it does not make the least difference of what kind of metals the bearing surfaces are made and what their condition is, so long as the two surfaces are definitely separated by a film of liquid under pressure. The fact is that the stationary and the revolving plates are both made of cast iron and in many cases they are not even machined.

The thickness of the film of water between the two plates is infinitesimal and yet it does the work in a manner so remarkable that it has no precedent.

Now imagine an American railway master mechanic on his vacation visiting in Switzerland and sitting down alongside of one of those turbine wheels as to what kind of ideas will run through his head? An irresistible desire will overtake him to convert the hydraulic-bearing principle into a method of lubricating locomotive driving boxes. As a man of vast locomotive experience he will know that all he will have to do is to force oil between the axle and the bearing under a pressure sufficient to lift the load slightly off the axle. But it will also occur to him that the oil will ooze out of the bearing and thereby be wasted. Here is the place where the best of us could be mistaken. The oil will not ooze out and will not be wasted. It may seem remarkable, but the fact is that less oil is needed with force feed lubrication than the amount used by ordinary methods heretofore. Let us see how this happens.

In present-day practice the oil is under pressure in the bearing, whether it is pumped therein under pressure or merely poured in. Its chief duty is to support the load. Then why does it not ooze out? If it would ooze out lubrication would be an impossibility, or at least more oil would be needed for the bearings than the volume of water converted into steam in the boiler.

The reason that the oil does not ooze out is caused by its surface tension, otherwise called viscosity, and by its adhesion on to metal surfaces. Both viscosity and adhesion offer a most definite amount of resistance, which must first be overcome

before any outward oozing can take place.

The law on the surface tension of liquids is thoroughly understood nowadays, and the amount of resistance it offers is of a definite character. In taking advantage of this law care must be taken, however, not to overdo a good thing, which is not hard to accomplish. For instance, if there is a bearing load of 400 lbs. to the square inch and oil is forced in under a pressure of 20,000 lbs. per square inch, all the surplus oil will flow out and be lost, but, on the other hand, if the oil is pumped in at only 415 lbs. it will lift the load off the axle, and the surplus pressure of 15 lbs. is not sufficient to break the viscous and adhesive resistance of the oil, and consequently it will stay in the bearing, and by its lifting power produce the greatest kind of an improvement in its running quality. It is not necessary to confine this difference to 15 lbs., it can vary several hundred pounds without overcoming the resistance power of the oil in viscosity and adhesiveness.

In present-day practice of lubrication the oil is made to support the load. In the McCord practice the oil is not only made to support the load. In addition, it is compelled to also *lift* the load and thereby the principle of the Swiss hydraulic bearing is brought into full play.

The McCord system of force feed lubrication consists of a method of automatic control of pressure and amount of oil used, and great care had been taken in its design not to exceed the viscous and adhesive resistance of the oil.

In generic principle the Swiss hydraulic bearing and the McCord force feed lubricator are practically the same invention with the difference that the hydraulic bearing is wasting all its lubricating material, while the "McCord" is wasting none of it. The "McCord" can be used on a Swiss turbine successfully, but a "hydraulic" cannot be used on a locomotive. The surface tension of water is comparatively small and the surface tension of oil is great, which permits this extraordinary maneuvering in lifting the load off the axle and thereby cause the absolute elimination of hot boxes and the almost absolute elimination of driving brass wear.

The pumping of oil in between bearing surfaces under a predetermined pressure sufficient to lift the entire load, but insufficient to overcome the resistance offered by the surface tension and adhesiveness of the oil, and thereby preventing its leaking out of the bearing, is the duty of the McCord Force Feed Lubricator in brief

Hints on High-Speed Drills.

Many failures in drilling are entirely due to bad grinding for any kind of drill must obviously be absolutely symmetrical on the cutting lips in order that the pressure shall be the same on both lips. The curve of the backing off must be such that the front edges of the lip are highest and concentric with the axis of the drill, and fall away sufficiently in the back portions.

The grinding of high-speed drills should never be done dry; neither should they be partly ground dry and finished wet, since surface cracks will be started, leading to the disintegration of the cutting edges, and subsequent complete fracture.

The drill must not be too thick at the point, since this leads to too great a pressure on the point of the drill, absorbs too much power to drive, and results in a "split" drill. When any particular drill has got thick through considerable grinding and consequent shortening, the point should be thinned on the grinder in the tool-room.

Care should be taken that the drilling machine spindle is in good condition, that is, it should be a good fit in its journals, and with no drop. A dropping spindle is responsible for a great percentage of fractured high-speed drills.

A common error consists in the use of an ordinary two lipped drill as a reamer; that is, a pilot drill, a 1/32 in. or 1/64 in. under size, is put through the job first. and the finishing drill made to follow. This is wrong, and leads to rapid failure, since a two-lipped twist drill has no proper support to its cutting edges, and will bind in the hole. The drill must never be driven into a hole beyond the limit of the spirals, since from this cause the flutes are blocked and disaster results.

Going beyond a certain temperature has a most deleterious effect, even on the best of drills, and on mild or cast steel an abundance of soapy lubricant should be used.

It is difficult to lay down an absolute rule as to rates of feeds and speeds at which drills such as these should be used, and notwithstanding the fact that charts for such are useful in a shop, considerable judgment should be exercised, especially in relation to the hardness and cleanness of the material being operated on.

Oiling Wedges.

How many engineers have had trouble with the poor oiling arrangements on top of wedges and shoes. They remind one of a hog trough with both ends out. There is generally a little corner chipped out of the top of the driving box next to wedge and shoe, and this often carried around the wings or projections on box, so that the oil is carefully ditched off and carried down to the ground via the frame, just as a farmer would scheme to drain a muck swamp of stagnant water. Why would it not be better to tap a good-size hole through from oil pocket on top of box to the wedge and shoe? It would be under the waste, and not be full of cinders half the time, as the present endless trough is. Wedges without oil soon cut and cause the engine to ride hard and prevent keeping the wedges properly set up. Our experience with sheet metal covers for driving boxes is that they catch and carry dust, sand and cinders away from the oil pocket, but onto the top of wedges and shoes. Waste above the covering tops of these exposed and important parts of the locomotive is better. It should be changed as soon as it gets dirty, without disturbing the lower layer of wool that feeds the journal itself.

Boiler Inspection.

The federal law in effect since July providing for boiler inspection, especially as to steam locomotives on railroads, is operating satisfactorily to railroad men, and to the advantage of service, according to one of the inspectors.

While there has been here and there, especially on some of the smaller roads, reluctance readily to comply with orders to make repairs, little difficulty has been experienced and it has not been necessary to resort to severe measures permitted by the law. The department is inclined to deal leniently with the roads. There has been little conflict with State inspection laws, and it is believed that eventually these will be allowed to give way to the more far-reaching and broader federal statute.

The need of federal inspection, it is contended, has been clearly proven. Defects previously prevalent and too often only partially remedied or overlooked are no longer tolerated. Examinations are critically made, and nothing is allowed to be slighted where the least possibility of a lack of safety presents itself. It is a noteworthy fact that nearly all of the inspectors are men of many years' experience on railroad work.

Tapping Hard Metal.

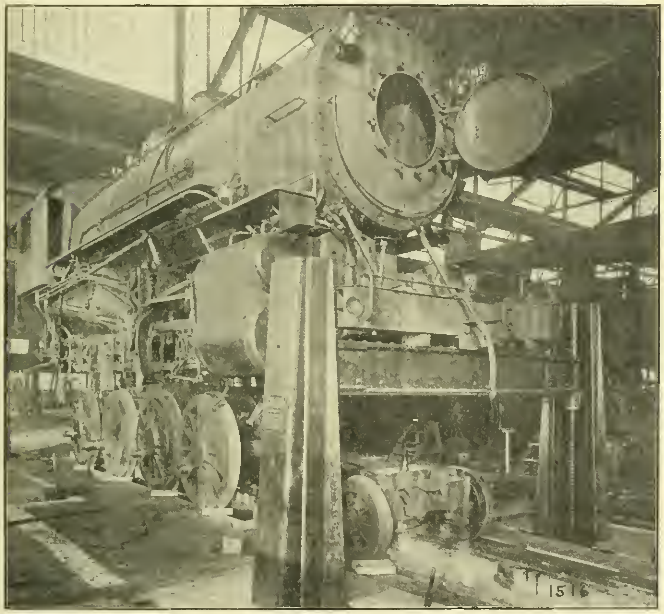
When tapping hard metal it is a very common occurrence for the tap to break. If the tap is ground away on the point, so that the first five or six threads will be gradually bevelled the trouble may be avoided. The effect of grinding the end of the tap is to break up the chips into smaller pieces and thus prevent clogging the threads of the tap. This will be found to be especially advantageous in tapping very hard rolled steel.

The more nearly steel approaches a pure iron, the longer it resists corrosion. Wrought iron, notwithstanding its slag, is the nearest approach as the slag is mechanically mixed and does not interfere with the chemical properties of the product.

Electric Screw Jack Locomotive Hoists.

In the new shops of the Chicago & Northwestern Railway, which were described and illustrated in the January issue of Railway and Locomotive Engineering, there have been installed several new mechanical appliances worthy of particular notice, not only on account of their adaptability to the work required, but to the important item of economy in their construction and application. Among these an electric screw jack locomotive hoist is perhaps the most noticeable. It is manufactured exclusively by the Whiting Foundry Equipment Company, Harvey, Ill., and although only a short time on the market it is already attracting much attention, and meeting with warm commendation from experienced engineers. As is well known, the overhead traveling cranes capable of lifting 200 tons require that great strength is necessary in the construction of the building. The new appliance, as illustrated, consists of two stationary screw jacks and two movable ones, located in pairs on opposite sides of railroad track on which runs locomotive to be wheeled or unwheeled. Stationary jacks are bolted to concrete foundation. Movable jacks are mounted on trucks having four wheels and operating on independent tracks parallel with locomotive track and having range of travel suitable for all locomotives to be handled. A removable structural steel girder extends from one jack to the other across the track at right angles, and located respectively under the tail bar and bumper beams of the locomotive.

Electric motor, either alternating or direct current, operates the hoisting mechanisms applied to each hoist independently or in any combination as may be desired. Motor may be from 25 to 40 horsepower, depending upon capacity and speed desired. The travel of movable jacks is conveniently accomplished by hand-operated device. This locomotive hoist is peculiarly suitable for all division points to permit repairs on locomotives without expense and delays of sending locomotives to the main shops. A 5-ton electric overhead traveling crane for stripping locomotives greatly facilitates the repair work in connection with the locomotive hoist. The entire cycle of operations, from locating jacks to suit locomotive to lowering on to shop trucks and clearing away everything preparatory to pulling out, has been repeatedly accomplished in one-half hour. As an addition to the mechanical appliances of locomotive repair shops it bids fair to meet with much popular favor.



ELECTRIC SCREW JACKS FOR LOCOMOTIVE HOISTS.

Purifying Water.

The Electric Water Purifying Machine Co., of Pittsburgh, is manufacturing a machine for the purification of water by means of electric current. If this can be done at a reasonable cost the method should be most promising.

Efficiency Tests on the Pennsylvania.

Over 500,000 efficiency tests were made in 1911 by the Pennsylvania Railroad, and the reports—made public last month —show that the employees have a record of 99.7 per cent. perfect.

Efficiency tests—at one time called surprise tests—as conducted on the Pennsylvania Railroad cover a wide range of subjects, such as "conformity to speed regulations," "observance of all kinds of signals," "leaving or arriving ahead of time," "car doors not properly closed," and many others of a similar nature.

Tests are conducted by division officials of the railroad, who at unusual times and places, check up employees in their work, to see that all rules and regulations are obeyed. Failure to observe any of the rules regarding the use of signals is immediately reported and the offender is called before the proper official for discipline.

In 1911 the Pennsylvania Railroad made exactly 543,572 efficiency tests and 99.7 per cent. recorded perfect. In other words, only three-tenths of one per cent. of these tests failed to find employees obeying the spirit and letter of the company's rules. In a very large majority of this three-tenths of one per cent., the observance of rules was partial, but any slight infraction was counted against the employee's record.

To Resharpen Old Files.

Wash the files in warm water to remove the grease and dirt, then wash in warm water and dry by heat. Put 1½ pint of warm water in a wooden vessel, put in the files, add 3 oz. of blue vitriol, finely powdered, and 3 oz. of borax. Mix well, and turn the files so that every one may come in contact with the mixture. Add 10½ oz. sulphuric acid and ½ oz. of cider vinegar. Remove the files after a short time, dry, rub with olive oil, wrap in porous paper. Coarse files should be kept in the mixture for a longer time than the fine ones.

Tempering Copper.

The tempering of copper, one of the most striking of the alleged lost arts of ancient civilization, has been shown by recent research to be a myth. In Mexico no trace of such an art is found among the remains of the Aztecs and Toltecs, and very superior cutting tools of the Balsas river ruins prove to be not copper but an alloy.

Analysis shows that the hardness is due to nickel and cobalt in the copper, some ores of the ancient metallurgists contained these metals, and the ores that supplied pure copper gave only soft implements. Bronze tools found in different parts of the world have been called hardened copper by mistake.

Questions Answered

GAUGE PRESSURE.

149. W. S. M., East Tawas, Mich., writes: Some discussion has been going on at the meetings of the Stove Committee here in regard to the pressure shown on steam gauges. One set of commentators insist that the gauge shows absolute pressure, while another division of logicians insist that the pressure recorded is that above the atmosphere. Which is correct?—A. Steam gauges show the pressure above the atmosphere which is 14.7 pounds per square inch above vacuum.

POWER OF WATERFALLS.

150. W. G., Boise, Idaho, writes: Is there any method of ascertaining the horsepower of falling water? There are a number of water falls in this locality, much admired by tourists who see them for the first time, but it occurs to me they could be put to some better use.—A. If the weight of water falling per minute can be correctly estimated, multiply the amount by the height of the fall and the result will be the amount of foot-pounds. This sum divided by 33,000 will give the horsepower. There are seven and a half pounds in each gallon of water. The tendency to overestimate the power of falling water is apt to lead to gross inaccuracies.

MEAN PRESSURE IN CYLINDERS.

151. J. B., Atlanta, Ga., writes: Can the mean pressure of steam in the cylinders of a locomotive be estimated at different points of cut-off without the trouble of applying an indicator?—A. Experiments have shown that the variable pressures at different points of cut-off have been reliably estimated. Multiply the boiler pressure of steam per square inch when the cut-off occurs at one quarter of the stroke by .597, at one-third by .670, at three-eighths by .743, at one-half by .847, at five-eighths by .917, at two-thirds by .937, at three-quarters by .966, and at seven-eighths by .992.

COMPRESSING AIR HIGHER THAN BOILER PRESSURE.

152. Fireman, Buffalo, N. Y., writes: One of our engineers told me that the Westinghouse air pump on his engine sometimes compresses air higher than the steam that is driving it. I thought such an assertion was rank nonsense and that you might as well expect one pound on one end of a weighing scale to balance two pounds on the other end, but I talked about the matter at a meeting of firemen and was surprised to find that several of them agreed with the engineer. As I understand you answer questions through your paper, I am writing to ask if you will settle the problem? A. It is perfectly true to say that a Westinghouse air pump will sometimes compress air to a higher tension than the steam driving it. The action is thus explained: At the beginning of the stroke the steam piston receives propelling force from a full pressure of steam, while there is little pressure of air behind the air piston to offer resistance. The consequence is that a certain velocity is imparted to the pistons, and before the end of the stroke is reached there is the momentum of the moving parts available for doing the work of compressing the air. Suppose that the two pistons and the rod weigh 50 lbs. and they get moving at a velocity of 10 ft. per second. This mass of moving metal now possesses energy that can be utilized for compression of air independent of the pressure imparted by the steam.

LAP CLEARANCE.

153. D. S., Memphis, Tenn., writes: I observe in some of your descriptions that the letters "C. L." are used in describing the valve motion. What does this refer to? A.—It refers to the amount of clearance lap of the valve in its relation to the exhaust ports. A valve, the inner edges of which exactly correspond with the inner edges of the steam ports, may be said to have no kind of lap, as the least movement of the valve opens either one or other of the steam ports to the exhaust port. Some valves are so constructed as to lap over the edges of the ports a short distance, the effect being to prolong the period of compression. Others fall short of exactly covering both ports and shorten the compression period, and this shortage is called lap clearance.

BLACK BOILER HEAD.

154. H. H. Tullahoma, Tenn., writes: In trying to keep my engine as bright and clean as possible, I have tried everything that I know of to get a bright, black, boiler-head, but have failed. Graphite and lard oil, and paint become gray and peel off. Could you or some of your experienced readers set me right?—A. We would be pleased to have the opinion of any of our readers who have had experience in the matter, but in the meantime ten parts of oil of turpentine mixed with one part of sulphur should be taken and boiled together and applied as lightly as possible.

WHEEL SLIDING.

155. G. N., St. Louis, writes: Is the engineer of a locomotive strictly responsible for slid flat driving wheel tires when the engine is equipped with the No. 6 E. T. brake, that is, should he be able at all times, to release the brake by means of the independent brake valve before the tires can be injured?—A. The manufacturers of the brake claim, and can demonstrate that there is practically no excuse for ruined driving wheel tires due to sliding if the brake equipment is maintained in good condition, but in all cases the causes and circumstances surrounding the wheel sliding should be thoroughly investigated before the responsibility is passed upon. In view of the fact that wheel sliding at high speeds is practically impossible and that under ordinary circumstances a peculiar vibration of the locomotive just before the wheels pick up, warns the practical engineer of the impending wheel sliding and as the application cylinder pressure can be exhausted in from 2 to 3 seconds' time and with fair piston travel the high brake cylinder pressure will be reduced to a safe figure in about the same length of time, there is very little opportunity for proving a good brake equipment at fault.

In past issues considerable space has been devoted to causes of wheel sliding on cars and locomotives and in this connection we will only add that the action of the S 6 brake valve in releasing brakes is somewhat delayed if the brake pipe reduction has passed the point of equalization between the pressure and application chambers sufficiently to allow the equalizing valve to move to full stroke or emergency position. In this case the pressure chamber and the application cylinder are directly connected with the application chamber cut-out and the independent brake valve must necessarily reduce both pressures and if for any reason the equalizing slide valve should become unseated the application chamber volume would be added to the pressure that must be exhausted before the brake can be released, however all three of these pressures will lower sufficiently for the wheels to start revolving in a very few seconds' time, but this action of the No. 6 E. T. brake should be remembered when too heavy a brake pipe reduction has been made.

WORK OF THE AIR PUMP.

156. A. H., Wheeling, W. Va., writes: What is a safe tonnage to handle on a 1¼ per cent. grade with one 11-inch air pump? —A. While tonnage handled on grades is not entirely a matter of air-pump capacity, we might call attention to an article on page 221 of the May, 1911 issue of Railway and Locomotive Engineering.

The experiments referred to covered a period of about two years' time, demontions were made in actual service, and from the results Mr. P. J. Langan concludes that the 11-inch pump will compress a sufficient volume of air for the handling of 60 loads or 70 cars, empties and loads mixed on a 1¼ per cent. grade.

The table printed in connection with the article gives the estimated number of cars upon which the maximum brake pipe pressure can be maintained by the 9½, 11, two 9½ or two 11-inch pumps when descending a 1¼ per cent., 1½ per cent. or 2 per cent. grade.

BRAKE STICKING.

157. Apprentice, Mobile, Ala., writes: Two engines equipped with the G-6 Westinghouse equipment, double heading in passenger service, arrived at a terminal with the driving wheel tires on the first engine slipped or loose, caused by brake applying lightly and remaining set. The triple valves and all piping on the locomotives were inspected and tested, the gauges were registering correct pressures and nothing was found wrong. What in your opinion was the cause of this trouble and could it be caused by what is termed a flash release?—A. The engine brake applying under the condition you mention indicates either a defective brake pipe feed valve or incorrect manipulation of the brake valve. The sluggish or irregular action of the feed valve would permit brake pipe leakage, or auxiliary reservoirs absorbing brake pipe pressure, to cause variations in brake pipe pressure which could originate the trouble you mention. Allowing the brake valve to remain in release position a trifle too long when releasing the brakes, thus overcharging the brake pipe, particularly at the head end, would be followed by a re-application, which if not "kicked off" by a secondary movement to release position might result in a stuck brake, such as you mention, but from this you will note that re-application or creeping on of brakes on the engine is prevented rather than influenced by the "flash" or momentary movement to release position.

FAILURE OF PUMP GOVERNOR.

158. J. M., Topeka, Kans., writes: With proper main reservoir and brake pipe pressures, should not the excess pressure head of the S. F. pump governor stop the pump when the brake pipe pressure is exhausted with the brake valve in running position and hold the steam valve closed until the main reservoir shows a considerable drop in pressure.—A. Yes, and if the excess pressure top fails to do this it is because it is defective or the flow of air to it is partly obstructed. It may be that the diaphragm fits too neatly in the spring-box or that there is an obstruction in the excess pressure operating pipe or in the ports that it connects either in the governor or brake valve.

Leakage from the relief port and past the governor piston packing ring while the governor is operating, necessitates the supply of a certain number of cubic inches of free air per minute and the higher the pressure the greater the volume of free air, or air at atmospheric pressure, that can escape from an opening of a fixed size, therefore the governor cylinder may receive enough pressure to stop the pump under a flow from a 90 or 100-lb. main reservoir pressure and fail to receive enough when the pressure has fallen to 70 or 80 lbs.

In the above it is assumed that all pipe connections are properly made, that the governor operates correctly save in the manner described, and that the pressure in the feed valve pipe and spring-box falls as it should, as you will note that in order for this excess pressure to stop the pump the pressure under the diaphragms must remain higher than the combined spring and air pressure above them.

COMPOUNDING PUMPS.

159. R. H., Cass, W. Va., writes: What pressure of air can be obtained with 100 pounds steam pressure by piping the discharge of one air pump into the receiving end of a second pump, both pumps being of the same size?—A. Assuming that the steam and air cylinders are of the same diameter and that the pumps are in good condition, the first pump should deliver air pressure at about 90 lbs., which would give a force equal to 100 lbs. steam pressure and 90 lbs. air pressure per square inch on the air piston of the second pump, which would result in a final pressure of 175 or 180 lbs. in an air-tight reservoir. The pressure that will be maintained under service conditions will be considerably less than this and will depend entirely upon the amount of compressed air that is used.

LAP POSITION OF TRIPLE VALVE.

160. J. M., Topeka, Kans., writes: Is there any difference in lap position of a K triple valve after quick service position and lap position after full service has been reached?—A. Not so far as any operating feature or control of pressure is concerned but lap position, assumed while the slide valve is in quick service position, leaves the triple piston some distance away from the graduating stem and lap position after full service is assisted by the graduating spring and stem as the graduating spring is partially compressed in full service position, consequently when lap position is then reached the piston is in contact, or very nearly so, with the graduating stem and the quick service ports are closed by the slide valve.

TEST OF BRAKES.

161: A. H., Wheeling, W. Va., writes: What is the surest way of knowing that all air brakes in a train are coupled up and working before descending a grade?—A. If special air brake inspectors are not employed for this purpose of determining the condition of brakes before trains are permitted to descend the grade, the train crew should know that all brakes are coupled up and operating before the train is started down a grade of any considerable length. The crew should also make an effort to correct anything in the way of excessive leakage or excessive piston travel if time will permit.

POWER TRANSMISSION.

162. J. L. M., of Boston, Mass., writes: How far can practical working power be transmitted from the power house?—A. The distance that electrical power can be transmitted depends on the voltage or pressure of the electrical power. The higher the voltage the longer the distance, and, moreover, the distance does not vary directly as the voltage but approximately as the square of the voltage. For instance, it would be possible to transmit four times as far with 20,000 volts as with 10,000 volts. There is a loss of power when electricity is carried over the wires, as there is a loss of power when steam or water is carried through long pipes, due to the resistance, and high voltage is required to force the amperes or electric current over the wire, as high pressure would be required to force steam or water through the long pipe. Voltages as high as 110,000 volts are used today with every indication that voltages as high as 160,000 to 180,000 will be used in the near future. With the 110,000 volts it is possible to send the electric power 300 miles economically. In this manner it is possible to use the power from a big waterfall, which may be some distance away, and send the electric power over the transmission line to the places where uses can be made of it for driving electric motors, etc.

Loosening Broken Studs.

Instead of drilling out broken studs and screws, drill a small hole in the center with an electric drill, and when the bottom of the stud or screw is reached fill the cavity with kerosene. If the screw is not then readily removable try two cap chisels on the surface, operating near the outer edges of the refractory screw, and a few blows on the chisels never fail to loosen the screw without in any way damaging the thread.

Broken Hammer Handle.

To extract the end of a broken handle from a hammer, axe or similar tool, don't heat it, but simply take a drill or bit as large as you can put through without striking the metal at the sides, and bore a single hole; then with a narrow chisel cut out a groove, like the keyseat on a pulley, on each side, dividing the wood into two pieces, which can then be easily driven or chiseled out.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances.

Published Monthly by

ANGUS SINCLAIR CO.

114 Liberty Street, New York.

Telephone, 746 Rector.

Cable Address, "Locong," N. Y. Glasgow, "Locoauto."

Business Department:

ANGUS SINCLAIR, D. E., Prest. and Treas.
JAMES KENNEDY, Vice-Prest.
HARRY A. KENNEY, Secy. and Gen. Mgr.

Editorial Department:

ANGUS SINCLAIR, D. E., Editor.
JAMES KENNEDY, Managing Editor.
ALLEN G. WOOD, Consulting Engineer.
GEO. W. KIEHM, Associate Editor.
A. J. MANSON, Associate Editor.

Boston Representative:

S. I. CARPENTER, 643 Old South Building, Boston, Mass.

London Representative:

THE LOCOMOTIVE PUBLISHING CO., Ltd., 3 Amen Corner, Paternoster Row, London, E.C.

Glasgow Representative:

A. F. SINCLAIR, 15 Manor Road, Bellahouston, Glasgow.

SUBSCRIPTION PRICE

$2.00 per year, $1.00 for six months, postage paid in the United States, Canada and Mexico. For other parts of the world, $2.50, or ten shillings. Single copies, 20 cents. Remit by Express Money Order, Draft, Post Office Order or Registered Letter.

Mailing address can be changed as often as necessary—always give old and new address, and if you subscribe in a club, state the name of the agent.

Please give prompt notice when your paper fails to reach you regularly.

Entered at the Post Office, New York, as Second-class Mail Matter.

Mallet Articulated Compound Locomotives.

Although the Mallet Articulated Compound locomotives are frequently described and illustrated in the pages of Railway and Locomotive Engineering, and details are given as to the latest changes and improvement in their constructions, questions are frequently coming to us in regard to their origin and history, and it cannot be other than interesting to many of our readers to refer to the subject from time to time in a general way, as railway men, like men engaged in any other occupation, cannot very well keep abreast of the progress of the time without knowing the salient features that marked the past, and the causes that led, step by step, to the present, and so illumine, as it were, the path that leads to the future.

It may be stated briefly that the distinguishing features of this type of locomotive are two sets of wheels, each having an independent set of frames, cylinders, pistons, crossheads, connecting rods and valve gear, yet all under one boiler and firebox. The rear set of driving wheels is held in the usual way by frames secured to the boiler, and to the high pressure cylinders attached to the boiler. The front set of driving wheels is held in frames which have a limited transverse motion about a pivoted joint or hinge joining them to the rear frames. This joint is located conveniently between the two sets of wheels. The low pressure cylinders which are in front are not fastened to the boiler, but are attached to the forward section of the frames with which they swing as occasion arises. The boiler is supported on sliding bearings which rest in the frames, and spring stops are usually provided to limit the amount of transverse motion.

The high pressure cylinders located near the center of the engine are supplied with steam directly from the dome, the steam pipes passing outside of the boiler and leading to the valves, and the steam after passing through the cylinders, instead of being exhausted to the smokestack, passes into a receiving pipe, which is furnished with flexible joints, and is carried to the low pressure cylinders in front of the engine, and is afterwards exhausted towards the smokestack. It will be observed that the front cylinders are much larger than the cylinders located near the center of the engine. This variation in size is intended to compensate for the decrease in steam pressure. The flexibility of the frames, and accompanying attachments, is rendered imperative in order that the engine wheels may adapt themselves to the curves common on almost all kinds of railroads. Swivel trucks are sometimes added to facilitate this movement. It should be borne in mind, however, that the weight of the engine placed on trucks is not available for traction, the weight placed on the driving wheels being only available for that purpose. It will be readily seen, therefore, that the extended or double wheel base of this type of engine gives an immensely added tractive power, while the double set of cylinders lend themselves readily to the compounding or complete absorption of the pressure of the steam. The chief reason being, as in all compound engines, that a longer stroke of the valve may be used on both sets of cylinders, the steam escaping from the high pressure cylinders at the end of the piston stroke being still at a comparatively high pressure is fully utilized in the front or low pressure cylinders. If the two separate wheel bases are kept within easy limits of curvature the tractive effort of the engine is increased more than twice that of a consolidation, and the amount of steam, and consequently fuel and water, is not much greater than that of the single and much less powerful locomotive. It may also be observed that if the tracks were perfectly straight a consolidation or even larger type of locomotive could be so constructed as almost to compete successfully with the articulated or flexible framed engine, but with existing conditions the Mallet type is a decided improvement in point of tractive power over that of any other locomotive hitherto constructed.

The underlying principle that distinguishes this kind of engine is not new. In Ireland the Fairlie engine was of this type, but both engines being mounted on swivel trucks, the success of the innovation was not marked. An improved type appeared in Austria with one rigid truck and one swivel truck. Both of these types were in use as early as the middle of last century. The type of engine was latterly greatly improved by Mallet, a French locomotive designer. It has been left for American locomotive builders, however, to demonstrate the possibilities of this type of locomotive, and nothing approaching the size of the American Mallet type of locomotive has yet appeared in Europe.

It should be remembered that while the perfected articulated type of locomotive appeared first in France, American locomotive builders had experimented with this type of engine even before the appearance of Fairlie's engine, which was literally two locomotives coupled together. In 1831, Horatio Allen, an eminent American engineer, was really the constructor of the forerunner of the articulated locomotive, although his efforts to distribute the weight of an engine over a number of wheels, and also retain its flexibility, was evidently too great a problem to be solved by means of the limited appliances in use at that time.

It may be added that the honor of building the first of what may properly be called the American type of Mallet articulated locomotive is due to the American Locomotive Company, when in 1904 they constructed for the Baltimore & Ohio Railroad Company a twelve-wheeled Mallet type locomotive, having three pair of driving wheels in each group, and a weight in working order of 334,000 pounds all on driving wheels. The locomotive was exhibited at the Louisiana Purchase Exposition where its performance attracted much attention.

It should be remembered, however, that the Baldwin Locomotive Works built a locomotive of this type for the Sinnemahoning Valley Railroad in 1892 to work on a grade of 575 feet to the mile. The engine had Vauclain compound cylinders 9½ ins. by 18 ins., and 16 ins. by 18 ins. Separate swiveling trucks were employed and the flexible steam pipe arrangement was also used.

It is not necessary to describe at this

time the many improvements in the details of the articulated locomotives perfected by American engineers. Suffice it to say that in many sections of the country its utility has been demonstrated beyond controversy. Its advantages in heavy freight traffic, especially on steep grades, has rendered work hitherto difficult of operation comparatively easy, and while it is generally conceded that the limit in size and weight must be almost reached with the present limitations of tracks and bridges and tunnels, whatever problems the future may bring it may be relied upon that they will be successfully met by American ingenuity and enterprise.

Broken Rails.

The numerous serious accidents that happened during the past winter has excited a strong demand for an explanation of why the breakage of rails is so much more common than it used to be. When one listens to the opinions of the talkative men whose voices are heard so authoritatively in the smoking rooms of sleeping cars, in clubs, and in other places where wise men talk together, the belief is loudly expressed that the Steel Trust in its greed of gain is selling to railway companies steel rails composed of inferior material hurriedly rolled into rails that are too weak to stand the shocks of modern traffic. The Interstate Commerce Commission has a board of experts investigating the cause of broken rails, which is likely to bring out all the information available about modern rails and the shocks to which they are subjected. When this report becomes public we do not anticipate that the whole blame of the broken rail will be place upon the railmaker.

The matter of broken rails has become so serious that its cause demands the most searching investigation possible by the powers having authority to carry it out. Broken rails have caused derailments of trains ever since railways began operating, but of late such accidents have increased out of all natural proportion to the traffic carried. During the last ten years 2,059 accidents, with 106 deaths, and 4.112 cases of personal injury is an appalling record of disasters recorded on American railways as having been caused by broken rails. Among the derailments of fast trains that have happened during the past winter there has been extraordinary good luck in the small loss of life, steel cars having prevented human slaughter in cases where failure of steel rails brought many persons close to destruction.

We notice already in the discussions that have arisen about the breakage of rails that the railroad companies blame the rail makers for turning out rails that are deficient in resiliency, too hard and unyielding, while the steel makers accuse the railroad companies of maintaining inferior road beds which fail to provide a substantial foundation for good rails and they point to the freedom from broken rails on the substantial road beds of European railways.

We do not think this point is well taken, for the railways in this country where the greatest number of rail breakages have been recorded, have road beds as substantial and as well maintained as anything to be found in Europe. Moreover, it is not the yielding road bed that is most likely to induce breakage, but the rigidly supported section which the wheel can strike like an anvil. The extremely cold weather endured by States east of the Rocky Mountains have subjected railway rolling stock to severe conditions unknown in Europe; while the light rolling stock universally employed on European railways do not impart shocks to the rails of half the intensity given by American cars and locomotives.

The railway officials who blame the railmakers for the production of inferior rails, point to the fact that light rails put into use twenty-five years ago give much better service than modern rails and are comparatively free from breakage. Conditions at the rolling mills are very different now from what they were when the light rails referred to were made. At that time when Bessemer steel manufacture was developing, all that was expected of a plant of two six-ton converters was twelve blows in twelve hours. This product was laboriously hammered into blooms and then rolled into rails at the rate of three hundred a day. The rails made in this slow manner were necessarily good and durable; but the expense of making them was high. Under improved methods the steel plant of two six-ton converters has been known to make sixty blows in twelve hours, and the capacity of converters has been increased to 10 tons while machinery has been put in operation by which a steel ingot of a section fifteen inches square is rolled directly into a rail at one heat.

When this tremendous acceleration in the method of rail making is considered, the question naturally arises: is the rail product as good as that made by the slower process? Does it require better material to stand such compression? Is it better that steel should be heated twice in the course of its rolling, with the consequent expansion, or is it better to compress a mass of steel into a rail at one heat and finish it as a dull red heat with the flanges nearly black? These may be open questions, but there is no question that the expeditious process enabled the makers to reduce the price of rails.

While aiming to cheapen rails by improved methods of manufacture the makers have gone on steadily using superior material. In the early days of the Bessemer process much of the ore used contained 0.10 per cent. of phosphorus, some of it as high as 0.15 per cent., and 0.20 per cent was by no means uncommon. Now ore containing 0.08 per cent. phosphorus at most is considered good for Bessemer, and in consequence of a more rigid selection of ores, Bessemer ores are proportionately scarcer and higher. In the old days when light tough rails were made, spiegel containing 10 per cent. manganese was used as a re-carburizer. Now spiegel containing 45 per cent. manganese, a grade of spiegel unknown twenty-five years ago, is in common use. The beneficial influence of manganese on steel as a hardener and toughener is widely appreciated and steel makers are putting three or four times as much of this expensive element into modern rails as was formerly the practice.

That is the railmakers' statement of the case. The railroads demand a hard tough rail, but the makers say that the two characteristics do not go together and that hardness is preferred owing to its superior wearing qualities even if it involves brittleness.

Professor P. H. Dudley, who is the best living authority on steel rails, recommends the use of hard steel and stiff sections.

Before venturing the . expression of judgment upon the cause of recent rail breakage it would only be fair to review the progress of railway rolling stock in the last twenty-five years. In 1883 there were very few locomotives that had more than 4-wheels connected and a weight exceeding 90,000 lbs. on these wheels was practically unknown, so that 22,500 pounds per wheel was the limit. The heaviest freight engines weighed about 120,000 pounds spread over 6 or 8 driving wheels. The freight cars were seldom more than 15 tons capacity and weighed about 52,000 upon the rail, the weight upon each wheel being about 6,500 pounds. A modern fifty-ton freight car puts about 141,000 pounds upon the rails at 8 points, each point putting a pressure over 17,600 pounds. Increase of load and increase of speed is the policy of the leading railroad companies induced by the constant pressure of State Legislatures and other influences to reduce compensation for transportation. In their efforts to reduce the cost of moving trains railroad companies have continued to increase the weight of locomotives until now it is by no means uncommon to find each driving wheel carrying 28,000 pounds and over. Then comes the all-steel passenger car weighing 120,000 pounds and over, dashing along at 60 miles and over. To those familiar with the facts there is no mystery in the breakage of rails. The marvel is that the breakages are not more numerous.

The Deflector Sheet.

The importance of an exact adjustment of the deflector or diaphragm sheet in the smokebox has induced extensive ex-

periments to be made in order to fix a reliable standard that could readily be applied to any size or class of locomotive. In this work the Committees of the Master Mechanics' Association have contributed much that is of real value in the proper adjustment of smokebox appliances. A fundamental necessity is the exact alignment of the smokestack and exhaust pipe, after which the deflector sheet should be so constructed as to extend at least half way over the face of the flues, and to the deflector there should be attached a movable apron or double sheet, as it is almost invariably found that the exact height of the deflector or distance from the bottom of the smokebox to the lower edge of the deflector sheet is a matter of experimental adjustment.

The chief factor in the proper fitting of the deflector sheet is the condition of the fire. If the fire burns particularly hard at the front of the firebox, it shows conclusively that the movable apron is too low and that there is a sharp draft passing through the lower flues. On close examination it will be found that the upper flues will become choked more rapidly than in the lower section. In moving the adjustment apron it may be stated that it is better to make the change a very small one and carefully note the effect. The evenness of the condition of the fire in burning is the end which must be attained by all properly adjusted smokebox attachments.

It may be readily observed that there is a tendency in the construction and repair departments of many railroad shops to fix certain specific dimensions in the location of deflector sheets—the space from the bottom of the smoke arch and distance from the flue sheet being set down as absolute in certain classes of locomotives. This is a gross error, and the fact has been repeatedly demonstrated that various kinds of fuel and even climatic conditions materially affect the steaming qualities of locomotives. In addition to this it need hardly be stated that the kind of road itself and the traffic conditions are of material consequence, as well as the varying amount of the loads to be moved by the locomotives all affect the draft upon the fire and render the proper adjustment of the deflector sheet a more or less constant and delicate cause of care to the engineer who is desirous of obtaining the best results from the locomotive in his charge.

An interesting volume could be filled with illustrations of devices that have been tried in smokeboxes with a view to meet the problem of equable firing and good steaming. We believe that what is known as the Master Mechanics' smokebox comes nearest to meet all the requirements of the situation, but it appears that the perfect appliance is not yet in hand; as many complaints from correspondents come to us. It has been suggested that a contrivance that could readily move the lower edge of the deflector sheet without necessitating the opening of the smokebox door would be a step in the right direction.

High Prices and Railroad Rates.

It is a singular circumstance that a large portion of the press and public have fallen into the gross error of attributing the increase of the cost of living to the railroads. Any one who takes pains to obtain even a superficial knowledge of the subject soon learns that while the cost of the common necessities of life have been rapidly advancing the cost of transportation has been slowly decreasing. The two things have little or no relation to each other. If freight rates were doubled at once the effect on the price of commodities would either not be felt at all, or felt so slightly that the market, would as far as the effect of the increase was concerned, remain as before, but in such a thing were permitted it would doubtless be taken advantage of to double the price of many products. Fifty pounds of flour from the most remote mill in the West is charged eight cents for transportation to the seaboard cities The consumer must pay the baker five or six dollars for this when it becomes bread. If the transportation was absolutely free the price would remain the same. The freight charges on a suit of clothes to or from any part of the United States does not exceed ten cents.

Probably the reports of the Secretary of Agriculture are the most reliable data available in relation to the prices received by the farmer for the produce of his land and the prices paid by the consumer for the farm products and the cost of transportation. On the latter subject the report states that "it has been determined that when the farmer receives 50 per cent. of the consumer's price, the freight charge on butter is about one-half of 1 per cent. of the consumer's price; grain of all sorts, 3.8 per cent.; cattle and hogs, 1.2 per cent; live poultry, 2.2 per cent.; wool three-tenths of 1 per cent."

The report not only exonerates the railroads for any responsibility for the cost of high living, but also maintains that the farmer is not getting a high price for his products, but that "the cost of distribution from the time of delivery by the railroad to delivery to the consumer is the feature of the problem of high prices which must present itself to the consumer for treatment." This points clearly and, we think, correctly to the chief cause of high prices, but as usual it is easier to point out an evil in our commercial life than it is to remedy it. The complex system of distribution of commodities would be difficult to abolish or even to amend, but the truth should be known and no good can come of blaming the railroad rates of transportation for the cause of the growing evil when such rates are so insignificant as hardly to be noticeable in the general summing up.

It is pleasing to note that some of the railroad clubs are taking up this question with a view of rectifying the popular mind. We cordially endorse such action. It is not only the proper province of railroad men to aid each other in the great work in which they are engaged but it is also equally becoming to defend themselves and their occupation and interests from ignorant or wilful misrepresentation.

The Weary Winter.

The great bulk of our readers, especially in North America, will be glad that the weary winter is over and although the blue-birds have been in no hurry prophesying spring it is all the more welcome now that it is here. The winter that has just passed will be memorable for its prolonged severity. It has been particularly hard upon railroad men, and although the mechanical appliances now in use are vastly superior to those available in the last century, the battle with the elements is as full of danger, and calls as loudly for the most strenuous efforts as ever. It is amusing to listen to the mournful complaints of the dwellers in great cities who are compelled perhaps to traverse a few blocks in a snow-storm, or wait, perhaps, for a few minutes longer than usual for the belated means of transportation in order to be conveyed from place to place. How would they like to stand in the cab of a locomotive ploughing its way through the Alleghenies, or fighting a blizzard in the Kansas flats, with the snow as high as the cab windows and the eye unable to distinguish where the white, seething earth and the wind-swept, blinding hurricane of snow meet each other, and the thermometer sinking into the Antarctic circle? Or how would the breaking of a truck spring and the consequent stoppage and the handling of frozen tools with numbed fingers and petrified whiskers stiffening into adamant in a Northwest wind let loose from some glacial cave, and pouring its frenzied fury on the shivering railroaders, suit them? Like the passionate lover that sang of Annie Laurie, they would simply lie down and die. But the work has to be done by somebody. And yet we hear of few complaints. Railroad men are heroic in the best sense of the word, because their constant and severe trials are nearly always experienced comparatively alone.

The dweller in the steam-heated city flat has his safety valve in the ready newspaper. If the snow is not immediately removed, he writes a letter asking for the removal of the Street Cleaning Commissioner, and ten thousand men are promptly but lazily at work to do his bidding. On the railroads nothing but the

sense of duty well done sustains the great body of enginemen and mechanics who battle with the elemental forces of nature, and pass from triumph to triumph unnoticed and unknown.

All honor to them and may the winters to come be tempered with more mildness, and the summers that are to be come softly suited to suffering humanity, and earth and air fall upon the world's workers like a benediction!

Scientific Firing.

There is constantly pouring into railroad service a fresh stream of locomotive firemen composed mostly of young men who wish to become expert firemen. For reasons not difficult to explain, we frequently receive applications from these young men, for inmation concerning the art of firing, and it affords us pleasure to select the best books within our reach, and these are numerous, so that inferior firemen are not deficient in skill for want of good instruction. As firing is our theme we will venture to place before our readers a few words on scientific firing.

To properly comprehend what happens to keep a fire burning we must understand something about the laws of nature as they are explained under the science of chemistry. Practical men are generally easily repelled by the strange names which they meet with in reading anything where chemical terms are used. An engineer or fireman who is ambitious to learn the principles of his business ought to attack the hard words with a little courage and perseverance, when it will be found that they are not nearly so difficult to make out as first they appeared to be.

A man may become a first-class fireman without knowing anything about the laws of nature that control combustion. If he becomes skillful at making an engine steam freely while using the least possible supply of fuel, he has learned by practice to put in the coal and to regulate the admission of air in a scientific manner. That is, he puts in the exact quantity of fuel to suit the amount of air that is passing into the firebox, and in the shape that will cause it to produce the greatest possible amount of heat. This degree of skill is often reached by men ignorant of nature's laws; but it is attained by groping in the dark to find the right way. A man who has acquired his skill in this manner is not, however, perfectly master of the art of firing, for any change of furnace arrangement is likely to bewilder him, and he has to find out by repeated trying what method of firing suits best. He is liable at times to waste fuel uselessly, or to cause delay by want of steam when anything unusual happens.

A knowedge of the laws of combustion teaches a man to go straight to the correct method, and the information gained enables him to deal intelligently with the numerous difficulties which are constantly arising through inferior fuels, obstructed draft due to various causes, and fireboxes badly designed.

The nature of fuel, the composition of the air that fans the fire, and the character of the gases formed by the burning fuel, and the proper proportions of air to fuel for producing the greatest degree of heat, are the principal things to be learned in the study of the laws relating to combustion. The air above, the earth beneath and the waters under the earth, are all composed from about sixty-five elementary substances which have combined together to form the immense variety of substances found in and around the globe.

The elements which perform the most important functions in the act of combustion are oxygen and carbon. Carbon is the fuel, and oxygen is the supporter of combustion. Combustion results from a strong, natural tendency that oxygen and carbon have for each other, but they cannot unite freely till they reach a certain high temperature, when they combine very rapidly with violent evolution of light and heat.

The fireman who studies the scientific principles of his business finds the work much more interesting than the man who merely thinks of throwing in enough coal to keep up steam. All the operations connected with the management of a locomotive are highly interesting to the man who loves his work. Nearly all occupations have attractive features peculiar to themselves, but we think from years' experience in the cab that the work of firing and running a locomotive is the most alluring within a range of wide experience. But to obtain the real enjoyment constant study of the work is necessary.

Mariotte's Law of Expanding Steam.

Students of steam engineering frequently come across the expression Mariotte's law, and we are afraid that the term is not popularly understood. It is generally given as the law governing the expansion of steam. A considerable part of the work done by steam is performed by the steam expanding after it has been cut off from the boiler supply. The steam expands according to the law as explained by Mariotte and Boyle, two famous physicists, for the expansion of gases, according to which the pressure varies inversely as the volume. That is, if a cubic foot of steam is permitted to expand until it occupies two cubic feet, the pressure will be one-half as great.

The calculation of expanding steam is made from vacuum, thus. Suppose we have a cubic foot of steam of a gauge pressure of 180 lbs. That is, $180 + 14.7 = 194.7$ lbs. absolute pressure. We permit this to expand to two cubic feet. Its pressure will be $194.7 \div 97.35$ lbs. absolute, that would be $97.35 - 14.7 = 83.28$ gauge pressure.

Steam performing work in a cylinder loses some energy, but for all practical purposes the above rule is good for the calculation of expanding steam.

Believe in Success.

No thought is quite so big as the thought of success; nor does any idea keep after us quite so persistently. It will not do to deceive ourselves by saying that we do not care for success. That will not do at all. So, right after the beginning of our talk together, let us say at once that we believe in success, that we cannot entirely trust the people who say that success makes no difference, and even if we fail in many things, nevertheless we want our very failures to be successes. We may say it is better to have tried and failed than never to have tried at all, and in saying that we still have at the bottom of it the real idea of success. The same thing is seen in that well-known line of Robert Browning's, "Not what a man does but what a man would do—that exalt him." That is, success holds on to a person who really holds on to success, until it finally raises him to its own level. The appearances may show failures and half successes, but success finally crowns the man who holds fast. We reach our "would-do."

Works of Art.

The people who produce works of art sometimes fall into serious mistakes by using their imagination in place of observation. A beautiful calendar illustrates Autumn scenes on American farms and forms a curious study. It may be intended to attract city youths to participate in the joys of farming, but it goes a little too far. It portrays American farmers in tight boots and claw-hammer coats, while their wives and daughters go out in the Autumn in high-powered automobiles to gather blood-red and golden apples off the same spreading gnarled oak tree, glowing in all the splendor of the Fall-glorified maple. Too much imagination spoils anything. We prefer Dan Brady's charge of the Scottish Greys.

Garlock's Packing.

When one sees a locomotive toiling along under a cloud of steam that comes mostly from leaky gland packing, we may be sure that the Garlock packing is not used on that engine. The makers, Garlock Packing Company, Palmyra, N. Y., claim that their packing never leaks.

Catechism of Railroad Operation

By Angus Sinclair

QUESTIONS AND ANSWERS.

Third Series Continued.

152. What should be done in case a reach rod breaks?

A. Block should be placed over the link block in the position that will enable the engine to start the train and to keep it moving slowly.

153. In case the reverse lever or reach rod got jammed at short cut-off, what should be done?

A. It would be necessary to remove the pin securing the reach rod to the tumbling shaft and then to take the same measures as with a broken reach rod.

154. For what breakages is it necessary to take down the main rod?

A. Broken piston, cross-head or joints, broken valve rod when steam cannot be kept out of the cylinder, broken main rod, strap or crank pin.

155. What accidents call for side rods to be taken down?

A. Broken side rod, broken main pin or broken side rod pin affecting that side.

156. When an accident happens that calls for the covering of the steam ports without the main rod being removed, how can the piston be oiled?

A. Sometimes it is possible to block the valve in such a way that oil will pass into the cylinder from the lubricating pipe. If this cannot be done oil must be squirted into the cylinder through some of the openings, such as can be made by removing relief valves or indicator plugs. When this cannot be done successfully it may be necessary to slack the cylinder head.

157. What would you do if the main rod back brass got too hot for safe running?

A. Would stop and cool off the pin, slack the key, administer a good supply of grease and graphite, then proceed slowly.

158. How would you proceed if the whistle stem broke?

A. Would keep injectors going till steam ceased to work them. Then would remove the broken part from the dome and drive a hard wood plug into the hole.

ACCIDENTS TO RUNNING GEAR.

159. What should be done in case a driving axle broke?

A. With a main driving axle broken close to the wheel all rods on the disabled side must come down. With any other driving axle broken, only such rods should come down as would give trouble to the other rods. With a broken main axle the cross-head must be blocked after the main rod has been taken down and the valve secured in the middle of its seat, the valve stem being disconnected. Before the rods have been taken down the broken end of the axle should be jacked up so that a good solid block of wood can be put in place of the oil cellar on that side, then the space between that block and the pedestal brace must be filled by another solid block. With overhung springs block under the spring saddle above the frame or take down spring and block end of equalizer above frame. All rods and eccentric straps must be removed on the broken side.

160. Should the back section of the side rod on a six-wheel connected engine break, what would you do?

A. Would take off both back sections of side rods and run in with forward wheels connected, taking whatever train the engine would handle.

161. Should the forward side rod section of the engine mentioned break, what must be done?

A. Take off all side rods and run light to end of division.

162. Should the back or front section of a side rod on a consolidation or other 8-wheel connected engine break, how would you disconnect?

A. Would take off both back or front connections, as the case might be, and run in whatever train the engine could handle.

163. Should the middle side rod connection of a consolidation engine break, how would you disconnect?

A. Would take down all side rods and run in without train.

164. Should the main rod crank pin break close to the wheel, what would you do?

A. Would take off the main rod on disabled side, block the cross-head and cover the steam ports. Then I would take down all the side rods and proceed light.

165. What would you do if the intermediate side rod was broken on a consolidation engine having the eccentrics on the axle ahead of the main wheel?

A. Would send to the nearest telegraph office, giving notice that my engine had to be towed in. Meanwhile I would take down the broken rod, but leave the others up.

166. In case the forward tire of a ten-wheel engine should break, what would you do?

A. Would jack up the wheel with the broken tire or run it upon a block until it was clear off the rail and the box up in the driving box jaws. Then take out the oil cellar and make a block to fit between the journal and the pedestal brace to carry the disabled wheel center clear of the rail. Would then run in without disconnecting, provided the rod had not been damaged by broken tire. Should the front side rod section have been bent by the broken tire, would remove all rods and run in light.

167. Should the engine you are running break a main tire, what would be your procedure?

A. Would block up the axle wheel the thickness of the tire, slack up the main and side rod keys and run in carefully without train.

168. Should the back tire break, how would you manage?

A. Would block up the wheel and axle far enough to clear the rail, would take off the back sections of side rods and run in carefully, taking particular caution in passing over frogs and switches

169. Should the back tire of an eight-wheel engine break, what would you do?

A. Would block up wheel as in other cases and would take down side rods. Would proceed slowly, but would not attempt to back up. Would consult with headquarters at nearest telegraph station.

170. What should be considered a bad tender or engine track wheel?

A. One with sharp flange, or flat or shelled-out spots in tread of wheel 2½ ins. or more in length.

171. What should be done if an engine truck wheel or axle breaks?

A. It should be entirely removed or blocked up so as to have the wheel clear of the rail, and the truck frame should be securely fastened to the engine frame by chains.

172. What should be done if a tender truck wheel or axle should break?

A. Would pursue the same course as with the broken engine truck wheel and fasten the truck frame with chains to the tender frame. Then would move slowly and cautiously to the nearest point where repairs could be made.

173. How should an engine be blocked for a broken engine truck spring or equalizer? Also for broken tender truck spring.

A. If pilot will not be too low, let truck frame ride on boxes; otherwise, block between top of boxes and truck frame. Blocking for a broken spring will vary according to the type of truck used. Some have a coil spring over each axle box and are easily taken care of; some have semi-elliptic springs with the spring

band against the tender frame and the ends of the spring resting on arch bar over axle boxes, while others have elliptic or coil springs supporting the truck bolster and resting on the sand plank. With the first block over the individual box; with the second block between truck bolster and tender frame; and with the third between the truck bolster and the sand plank.

174. What should be done in case of a driving spring, spring hanger, or equalizer breaking?

A. Remove broken parts and block over box affected by break. In regard to blocking equalizers properly, one would have to be governed by the type of spring attachments used.

A Lesson on Valve Motion.

By Old Jack.

When I was a "cub" around the shop we had lots of old locomotives, hook motions, as well as links, and I got pretty handy at doctoring valves that were "out." A few years ago my engine was in the shop, and I worked for a couple of months in the roundhouse. One day an engine was ready to go out that had just got a half rebuild in the roundhouse; the foreman asked me to set her valves. I did so, proceeding in the usual way; got her dead centers, made her port marks on valve stems, by using tin in ports and a good steel tram, divided the travel very carefully and pronounced her O. K., but she was not. Her engineer took her out into the yard and she started off, holding up one leg as if some one had stepped on her corns. He brought her back and I went over every point again, but could find nothing wrong.

They got the pet valve man out of the back shop; he was an English machinist, and had his nose at an angle of 45 degs. at the very idea of letting a "driver" set valves. He explained to me that an engine at work had a big load on her valve, and he had a couple of coil springs that he rigged up each side of the rocker box to keep up all slack, and after it all did not change a bolt I had set, and still she limped.

They examined her nozzles, her valves and valve seats, and all were as they should be. All hands were stuck. The division master mechanic sent out in the yard for an old engineer running a switch engine. He had lost a foot in some former wreck on the rail. He hobbled into the roundhouse on a cork foot, and the master mechanic said: "Peggy, the cob chopper won't chew her cud square; I wish you would take her out and see what is wrong. Take John along and give him a few pointers." I had fired for old Peg years before when he had use of both hoofs. We went out and up along a side track, and Peggy turned to me and said: "Jack, are you sure you have her all right, line and line?" I was sure, I set the tank brake and ran the engine slowly, and Peggy hobbled along side of her, looking for her limp.

We stopped, and the old man came to the gangway and said he guessed he had it cornered, and asked for a half dozen coal checks. I got them and got down. "Now, Jack," said Peggy, "you see, as sure as you live, one of these link motion engines has got to be right, and I believe this engine's valves are square as a die; she ain't lame at all; she's lapsided. Get a monkey wrench." I got one. "Now, Jack, you stand down here and squint across the top of them arms to the tumbling shaft; looks like they were straight, and yet it don't; maybe they are, maybe they ain't; but we'll get this here scrap square, all the same, by the tumbling shaft. You see, if one of them arms got bent a little in kicking around the shop or being put up, or if one of the pins was wore more than the rest, or one of the hangers was a trifle too long, or one of the rocker boxes were a leetle high or low, it would make it impossible to find where she was out of the trams; it would be jest the same as if she had two reverse levers and one of them was working a notch harder than the other. Now, you loosen up this tumbling shaft box on this side, and we'll block her up a trifle with cardboard and see how she acts."

We did so and she was better; we gave her a few more tickets and she was square. The old man trimmed off the cardboard outside the box and smeared the edge over with black grease. We went down in the yard and got hold of a string of cars and pulled by the shop with every exhaust just exactly like its twin brother from the other side. To the valve expert's questions the old man replied, "You fellows got her stack on wrong side before," winking at me. To the master mechanic he said, "I guess the boys made a little mistake in making the new rocker arm or box or in setting it, or perhaps the arms of the tumbling shafts are bent. It would be better to go over those points and correct the real fault, and take that gun wadding out from the box of tumbling shaft; still she is old, and it won't hurt her to run that way. Next time you have a bad case of limp send for John here; I have been giving him a few lessons in the artificial leg business."

And, giving me a sly punch under the arm, he hobbled out into the yard and read a paper in the soothing shade of the water tank, keeping his weather eye on the motions of his fireman, who weighted coal cars and played engineer.

Machinist-Engineers.

When this publication was so young that it had hardly reached the years of discretion it endured a long controversy concerning machinist-engineers. The discussion excited considerable bad feeling and was the reverse of being edifying.

A correspondent has again tried to reopen this controversy in a letter just received. The question was finally settled long ago by most all roads promoting firemen only. We know of no good reason why a machinist would not make a good fireman, and, in time, a good engineer, provided his shop experience did not make him bigoted enough to disdain, instruction from a "cornfield engineer" with road experience only.

Of two men, equally adapted to railroad service, one from a machine shop and the other from a farm, the man from the shop ought to make an engineer before the man from the farm.

There is no more reason why a machinist "who knows how to build a locomotives," as our correspondent put it, should be more competent to run one than there is reason that a sailmaker could manage a ship at sea or a blacksmith who makes picks should know how to mine coal.

Most Popular Instruction Book.

The number of hand books published for the instruction of enginemen and others interested in locomotive running and management have been legion, but none of them holds popularity equal to that enjoyed by Engine Running and Management by Angus Sinclair. That book was published in 1884 and immediately became popular, for it was written by a man running a locomotive, the notes forming the book having been taken during trips or after the day's work was done. The book not only told in plain language how to deal with the numerous difficulties encountered on the road, but it gave clear directions of how to run all sorts of engines in the most advisable manner. The book has been revised repeatedly and brought up to date and sells in this office for the modest sum of two dollars.

The Bravington radium watch which has recently been put upon the British market is so constructed that the time can be seen in the dark. A watch of this character would be highly convenient for railway men and is likely to prove popular among them. We have been informed that the Howard Watch Works, Boston, are arranging to make the Bravington watch. Nearly all enginemen will find this a most convenient watch, and they should write to the makers asking for particulars.

Air Brake Department

Piping Diagram.

This issue contains a piping diagram for two 11-in. air compressors and two main reservoirs.

It is a well-known fact that the maximum capacity of an air compressor cannot be obtained unless the steam, exhaust and air discharge pipes are as large as the recommended size.

The diagram shows that for the two 11-in. compressors a 1½-in. steam line with 1¼-in. branch pipes, a 1½-in. steam valve and the S6 governor is required.

If one exhaust pipe is used for both pumps, 2½-in. pipe is recommended from the junction of the pipes to the exhaust.

The main reservoir piping shows the connections, arranged in a manner that permits the air pressure to leave the main reservoirs from the opposite ends from which it enters.

Not less than 25 ft. of pipe is specified for the length of the discharge and connecting pipes to the intent that the compressed air will be given an opportunity to cool to the temperature of the surrounding atmosphere and deposit the moisture before it leaves the reservoirs.

When a leak of air occurs at an exhaust port at a time it should not exist, it is termed a blow and at such a time some valve is being held off its seat by dirt or the valve is worn in a manner that will require re-seating or "facing off."

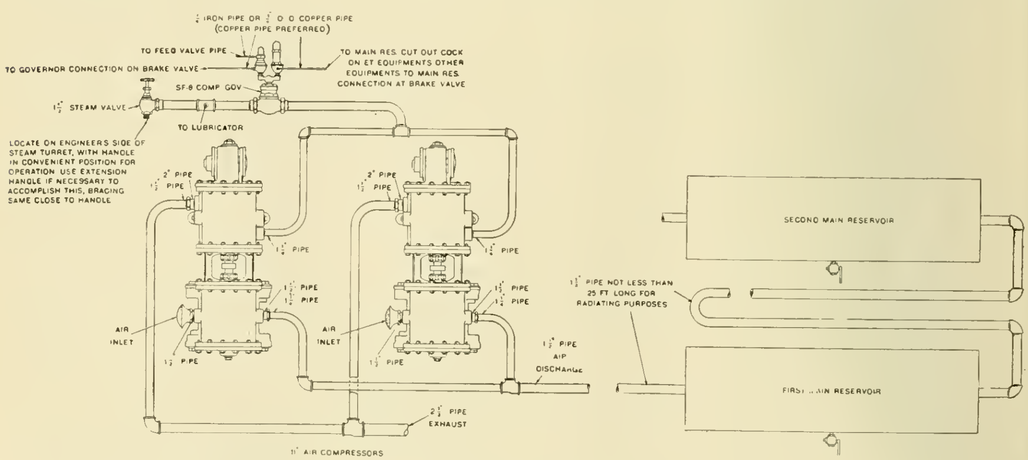
Before any repair work can be done the defective part must be located, and this is readily done if a little thought is given to cause and effect and in the following we will consider a blow coming from the exhaust port of the automatic control valve or from the exhaust ports of the brake valves and describe a method of testing to locate the source of the blow.

Before touching upon any particular disorder it will be understood that as with any type of brake the effect of a combination of disorders is somewhat problematical and we will deal with but one at a time, and at a time when it first develops. When dealing with a blow from an exhaust port there is always a possibility of a flaw in a casting which usually requires a special test to locate but in the following we will only deal with disorders resulting from wear or neglect.

If a blow is found at the control valve check valve. Should the below continue with the reservoir pressure cut off it would indicate a leak from the triple cylinder cover gasket or from the emergency slide valve and as it is no longer permissible to dismantle apparatus of this character in the engine house, a removal of the movable portion would disclose the control reservoir gasket. If this gasket was defective through a leak from the main reservoir or brake pipe ports into the brake cylinder port it would produce the same effects described, and would indicate a leaky admission valve or brake pipe leakage depending upon the point at which the gasket is defective.

Leakage from the exhaust port when the brake is applied indicates exhaust valve leakage. However an intermittent blow from the exhaust port while the brake is applied would indicate leakage into the brake cylinders from some other source which acted to increase brake cylinder pressure above control reservoir pressure forcing the control piston and exhaust valve to a position to exhaust the increase of brake cylinder pressure to the atmosphere.

A heavy blow coming from the control



WESTINGHOUSE PIPING DIAGRAM.

Leakage in L. T. Equipment.

When the operating valves of an air brake equipment are neglected for a sufficient length of time, disorders are sure to occur as the loss of lubricant and presence of foreign substance between the faces and seats of movable valves will tend to cause undue wear and leakage exhaust port while both brakes are released, it may be from the admission valve, from the emergency slide valve, from a defective triple cylinder gasket or from a defective control reservoir gasket. If the blow ceases shortly after the stop cock in the supply pipe is closed it indicates a leaky main reservoir admission or valve exhaust port just as a release is attempted following an emergency application or rather a continued blow from the exhaust port at this time would indicate a "stuck open" or unseated emergency slide valve.

If the heavy blow occurs before an attempt is made to release the brake it in-

dicates a "stuck open" admission or check valve.

In the former case the stop cock in the brake pipe branch to the control valve would be closed, in the latter case the stop cock in the main reservoir supply pipe to the control valve would be closed, and in either case the engine brake can be operated in conjunction with the train brakes by means of the straight air brake.

A light blow from the control valve exhaust port that occurs just as the application of the brake starts and ceases as soon as the brake does apply and manifests itself at no other time is due to excessive leakage past the packing leather and ring on the control piston.

With the automatic brake released a blow from the control valve exhaust port, only at a time the straight air brake is applied, is from the leather seat of the double check valve.

Leakage from the straight air brake valve exhaust port indicates leakage from the slide valve and seat of the straight air brake valve.

Leakage from the straight air brake valve exhaust port only at a time the automatic brake is applied is from the leather seats of the double check valve or if the leakage is accompanied by a falling of brake cylinder pressure it will indicate leakage from the automatic exhaust valve seat of the straight air brake valve.

A blow from the emergency exhaust port of the automatic brake valve, when on lap position, is from the brake valve rotary.

If the blow from the exhaust port occurs only while the valve is in running position it indicates triple slide valve leakage from the control valve.

A broken brake valve body gasket or a defect in a brake valve casting would conflict with the above as a fixed rule, and it is sometimes the best policy, and the safest in all cases where the blow occurs with the valve in running position, to disconnect the retain pipe and note whether the blow is coming down from the brake valve or up from the control valve before deciding which part is at fault.

A blow from the brake pipe exhaust port of the automatic brake valve is due either to dirt or foreign matter on the seat of the equalizing piston or to a variation in the pressure surrounding the piston.

With brake pipe pressure under the discharge valve and equalizing reservoir pressure above it, when the valve is on lap position it follows that in this position any decrease in equalizing reservoir pressure or any increase in brake pipe pressure will have a tendency to lift the discharge piston and exhaust brake pipe pressure.

In release, running and holding positions the brake pipe and equalizing reservoir are connected so that leakage from the exhaust port while the valve handle is in running position would indicate some obstruction between the valve stem and seat while if the leak occurred only after the valve handle was placed on lap position it would indicate equalizing reservoir leakage.

Leakage from the equalizing reservoir could occur in the reservoir itself, in its pipe connections, in the air gauge, in the gauge pipe, from the middle gasket in the brake valve, from the pipe bracket gasket, from the bolt holes past the bolt heads under the lower case or it may be caused by a cut on the face of the rotary valve or its seat.

Whether this leakage will always cause the piston to unseat and discharge brake pipe pressure when the brake valve handle is on lap position, depends upon the volume of air in the brake pipe, the amount of leakage and the condition of the equalizing piston packing ring.

If the brake has been operating correctly and the exhaust should fail to close after an application and return to release and running position it would indicate some obstruction between the valve and its seat.

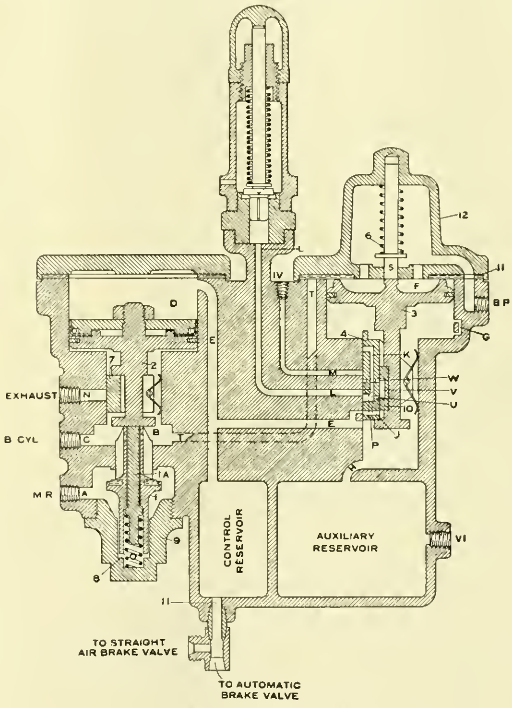
After an occurrence of this kind and at the first opportunity a full service reduction of brake pipe pressure should be made and the brake valve cut-out-cock closed, a movement to release position would then result in a violent rush of air to the under side of the piston which will remove the obstruction if it can be done without taking the valve apart.

Under no circumstances should the handle be placed in emergency position to remove the obstruction, as this would quickly withdraw the brake pipe pressure, leaving the equalizing reservoir pressure to force the valve to its seat, and if the obstruction was a piece of metal it would be imbedded in the brass.

If such an action was to occur out on the line of road and the obstruction could not be removed in the manner described and the leakage is too great to be allowed to continue the exhaust port can be plugged and the brake valve used as a three-way cock to the end of the trip.

If the blow started while going along the road with the valve handle in running position and the brake could not be kept from applying by a movement to release position it would mean a broken equalizing reservoir or gauge pipe and both the broken pipe and the brake pipe exhaust port should be plugged and the brake valve used as a three-way cock, going slowly to emergency position to apply brakes and moving back to lap position very slowly after the desired reduction.

A blow at the brake pipe exhaust port only after a heavy reduction that had passed the point of equalization between



AUTOMATIC CONTROL VALVE.

auxiliary reservoir and control reservoir volumes or brake pipe and brake cylinder volumes would indicate leakage into the brake pipe, presumably from the cylinder check valve in the quick action cap of the control valve, if the engine was alone. If coupled to a train it indicates back leakage from triple valves in the train.

Leakage from the straight air brake safety valve is either from dirt on the seat of its piston valve or from an improperly adjusted or defective reducing valve.

To determine which part is at fault the straight air brake can be applied and if the gauge registers 40 lbs. brake cylinder pressure it points to a leaky safety valve, but if the gauge registers 50 lbs. or more (the figure of safety valve adjustment), it points to a defective or improperly adjusted reducing valve.

Wrongly Used Brake Valve.

During the past few months a number of our corresponednts have written us with reference to the effect of using the H 5 and H 6 brake valves on the wrong equipment, that is, through some mistake the H 5 brake valve would be used on the No. 6 equipment or the H 6 brake valve would be used on the No. 5 equipment.

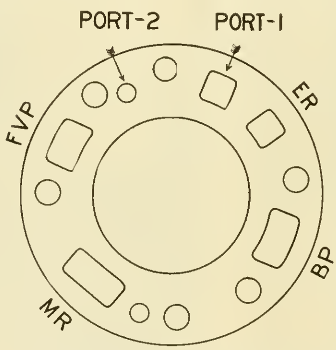
Our readers are well aware that the H 6 brake valve can be distinguished from the H 5 valve by the brass name plate attached to the rotary valve seat of the H 6 brake valve, but as the screws holding the plate are sometimes removed and used for other purposes, and the screw holes become filled with dirt, the H 6 valve is sometimes mistaken for the H 5. Should the name plate of the H 6 valve be removed, this valve can still be distinguished from the H 5, without taking the valve apart as a photographic view of the H 6 valve taken from a point facing the service position handle notch of the upper case, will show two series of lugs or projections on the upper case, rotary valve seat, and lower case, one series on each side of the valve when facing it from the point mentioned. Those lugs are intended to facilitate the operation of separating the different portions of the brake valve and a similar view of the H 5 brake valve shows when facing the service position notch on the upper case, but one series of lugs cast on the portions mentioned, and very near the point of the location of the number plate on the H 6 valve there is a small raised portion on the H 5 valve and by this the brake valves can be distinguished at a glance.

The reason that the valves resemble each other so much in size and appearance is that the valve handle, rotary key, upper case and lower case, as well as all the gaskets, are a standard for both brake valves, the only difference in the two valves being in the ports and passages in the rotary valve and seat, therefore either brake valve fits either pipe bracket.

In order to determine the effect of using the wrong brake valve on one of these equipments, it is only necessary to consider the brake valve, the bolt holes and port openings are the same in both middle and lower gaskets the only difference being that the upper gasket is made of leather and the lower of rubber and to find the effect of the wrongly used brake valve it is only necessary to consider the port openings marked 1 and 2 in the sketch of the port openings through the body gaskets.

The port openings in the lower case and the base of the rotary valve seat must, of course, register with the openings through the gaskets and on a No. 6 equipment, port shown as No. 1 leads to the release pipe and exhaust port of the equalizing slide valve and port No. 2 leads to a branch pipe to the application cylinder pipe.

On the No. 5 equipment port No. 1 leads to the application chamber pipe and port No. 2 to the branch of the double



VIEW OF PORTS AND BOLT HOLES FROM THE UPPER SIDE OF THE LOWER CASE OF H5 OR H6 BRAKE VALVE.

heading pipe between the brake valve and the cut-out-cock.

As the admission of main reservoir pressure, the equalizing discharge feature and the exhaust of brake pipe pressure is identical in both brake valves, the same ports through the lower case conduct the pressure to and from the brake system regardless as to whether the upper portion is of the H 5 or H 6 brake valve, but the two numbered ports are used for different purposes by the two valves.

Knowing where these ports lead to we will assume that the No. 6 equipment has in some way had an H 5 brake valve applied to it and we wish to know its effect.

It is manifest that the brakes will apply and release in the same way that the H 6 brake valve would apply or release them, but when the valve handle of the H 5 brake valve was returned to lap position the application cylinder pressure would escape and the engine brake would release because the H 5 brake valve opens the double heading pipe to the atmosphere in this position and on the No. 6 equipment a branch of the application cylinder pipe connects with this open port at the pipe bracket.

Should this branch of the application cylinder pipe be plugged or should it contain a check valve, as it does when the brake valve cut-out-cock is located in the reservoir pipe, the H 5 valve will do the same work that the H 6 valve will, with the single exception of maintaining the application cylinder pressure when the valve handle is in emergency position. Locating the brake valve cut-out-cock in the reservoir pipe is a Pennsylvania R. R. design, but is sometimes used on other systems.

Should the H 6 brake valve be used on the No. 5 equipment no difference in the action of the brake would be noticed in any position of the brake valve while this engine is handling the brakes in a train. In emergency position there would be no flow of pressure to the distributing valve from the brake valve, but the pressure maintaining feature of the No. 5 equipment is made in the distributing valve. The H 6 valve would also exhaust the equalizing reservoir pressure instead of admitting it to the application chamber, but those features are of minor import when the exhaust and restoration of brake pipe pressure is the chief issue.

While the brake valves may become mixed and wrongly used and act in the manner described it is needless to say that in all cases the brake valve should be used with the equipment for which it is intended.

It is not difficult to distinguish any parts of the No. 5 equipment from those of the No. 6 as the brake valves and distributing valve of the No. 6 equipment have the name plate and should the plates be removed or accidentally torn off, the automatic brake valves can be distinguished as stated, and while the other valves of the equipments are similar in size and outward appearance, the S F 1 brake valve of the No. 5 equipment has 3 pipe connections while the S 6 valve has 4.

The distributing valve reservoir of the No. 5 equipment has a ⅜-inch brake pipe connection while the reservoir of the No. 6 brake has a ¾-inch brake pipe connection.

The E 1 safety valve connects with the No. 5 distributing valve by means of a standard ½-inch pipe thread, whereas the E 6 safety valve is screwed into the No. 6 distributing valve through a threaded connection, that is 1 7/16 of an inch in diameter and 16 threads per inch.

It is a good and safe rule to sojourn in every place as if you meant to spend your life there, never omitting an opportunity of doing a kindness, or speaking a true word, or making a friend.—*John Ruskin.*

Air Pump Efficiency.

In using the expression "efficiency of the air pump" we sometimes confuse the term with air pump capacity, and it is needless to say that those two terms have somewhat similar meanings. We understand the capacity of an air pump to mean or represent the quantity of air the pump can compress in a given length of time when in good condition. The capacity of a pump is found by what may be termed "measuring" the volume of free air that is being compressed, and thus the capacity is limited by the size of the air cylinder, and pressure of air being operated against strokes per minute, and the condition of the pump in which strokes per minute is governed by the steam pressure per square inch, and the size of the steam supply pipe, and the effect of high temperature of the air cylinder and clearance or dead space in the ends of the cylinder being incidental to the factor "pressure of air being operated against." The pump's ability to perform work being limited, it is evident that the work to be done may be in excess of the pump capacity and have no reference to or bearing upon the pump's efficiency. A positive and practical method by which to determine an air pump's efficiency under any condition is to allow the pump to work against an opening of a known size in the volume of air that is being compressed, the size of the opening the pump will be able to maintain pressure against constantly or without permitting a loss of pressure will determine the pump's efficiency.

Many students of the air brake in some way become imbued with the idea that capacity of the 11-in. and 8½-in. cross-compound pumps are such that they require discharge pipes of 1¼ and 1½ ins., respectively, to conduct the volume compressed to the storage reservoirs.

While this size of piping is correct and there are very good reasons for using pipe of this size it is a fact, nevertheless, that the 8½-in. cross-compound pump at its maximum speed derived from 200 lbs. steam pressure through a 1-in. steam pipe and working against 130 lbs. air pressure can compress air about as fast as it can escape through a ¼-in. circular opening, which will expand approximately 125 cu. ft. of free air per minute, and the compressor must be driven to its maximum rate of speed obtained from 200 lbs. steam pressure and the use of a 1-in. steam pipe in order to compress this volume of air.

It is generally understood that speaking of air pump capacity has reference to the work the pump will do in a certain length of time when in good condition, and the word "efficiency" has reference to the condition of the pump itself.

However, the efficiency of an air pump is, its actual capacity in cubic feet of free air compressed, as compared with its theoretical capacity. It being taken for granted that the pump is in perfect condition in either case.

The theoretical capacity is a cylinder full of free air compressed on each stroke. The efficiency of the pump is the actual capacity's per cent. of the theoretical capacity. The actual capacity is, of course, less than the theoretical capacity, and the principal difference is, space in the air cylinder from which air cannot be compressed, temperature of the cylinder, pressure of air the pump is working against and the amount of compressed air that gets back into the cylinder while the discharge valves are seating. Naturally, the weight of air valves, space taken up by the piston rod and changes in atmospheric pressure and temperature also contribute to lowering the pump's per cent. of efficiency.

The effectiveness of the machine is therefore judged by the work it performs as compared with the amount of work, its size and speed would indicate its ability to perform.

To calculate the per cent. of efficiency of the 9½-in. air pump and disregarding all losses of minor import we would encounter the following simple problem in arithmetic.

Determined by test the actual capacity of a 9½-in. pump, running at a recommended speed of 120 single strokes per minute against an air pressure of 100 lbs. is approximately 28 cu. ft. of free air per minute.

The theoretical capacity is found by ascertaining the number of cubic inches of space contained in the cylinder from which free air should be compressed upon each stroke.

In this case we then have the diameter of the air cylinder 9.5 × 9.5 × .7854 which equals 70.88, which multiplied by the stroke in inches which is 10, we have 708 cu. ins. of space from which air at atmospheric pressure should be compressed on each stroke. At a speed of 120 strokes we would have 708 cu. ins. multiplied by 120 strokes equaling 84,960 cu. ins., or 49 cu. ft., 28 cu. ft. actually compressed divided by 49 cu. ft. equals .57, or the pump's efficiency is 57 per cent.

If the 11-in. pump is to be considered we would find a more efficient machine principally because of a longer stroke, and a calculation will show that squaring the diameter of the 11-in. cylinder by multiplying by .7854, and then multiplying the result by 12-in. strokes we find that during 100 strokes the theoretical capacity of the pump should be 65 cu. ft. of free air compressed per minute. Working at a speed of 100 strokes per minute against 100 lbs. air pressure this pump will compress 45 cu. ft. of air, 45 ÷ 65 = .69, or the 11-in. pump's efficiency at this rate of speed is 69 per cent. The 8½-in. cross-compound pump is a much more efficient machine, and in considering the theoretical capacity of a compound pump it is evident that its utmost capacity would be the low-pressure air cylinder full of free air compressed on each stroke. To find this pump's per cent. of efficiency we note that the low-pressure air cylinder is 14½ ins. in diameter, the area is 172.7 sq. ins. and the capacity of the cylinder 2,072 cu. ins.

During 110 strokes the pump should compress 126 cu. ft., according to theory, and it actually does compress 110 cu. ft. of free air per minute when running at a speed of 110 strokes per minute, its per cent. of efficiency is 110 ÷ 126 which is .87 or 87 per cent. This pump's high rate of efficiency is due to the fact of the low-pressure air piston operating against a resistence of but 40-lbs. pressure per square inch. Another distinct reason becomes apparent when we consider that the air valves, seats and cages are located in the lower head and in the center piece.

The valve's proximity to the low-pressure air cylinder permits of less "dead" space from which air cannot be compressed. A very important phase in connection with air pump efficiency is the degree of heat generated during compression. It is generally understood that the higher the pressure per square inch, the higher the degree of heat that is generated by forcing the fine particles of air together, and it is clear that compressing the air to but 40 lbs. does not generate a very high degree of heat.

In order to appreciate to just what extent a high temperature of the air cylinder effects the pump's efficiency it is necessary to ascertain the capacity of an air pump at a time when the air cylinder is overheated and to again note the capacity after the air cylinder has been cooled down to a moderate temperature. The effect of a cylinder full of coal air, or air at atmospheric temperature is relied upon to counteract the effect of the high degree of heat generated during compression, and merely holding the hand over the air strainer of an overheated cylinder will give an idea as to just what extent the high degree of heat is excluding the admission of cool air into the cylinder, and it will occur to the observer that the first small quantity of air that lift the receiving valve is expanded so rapidly by the overheated cylinder as to almost totally destroy what is commonly termed "the suction." With

this high temperature in the cylinder, the pump can compress but a very small quantity of free air, while if the same cylinder is cooled down to a moderate temperature it will become fairly efficient without any repairs being made.

In calculating the efficiency of the New York No. 5 Duplex compressor, we could encounter a slightly different proposition as this pump receives free air through separate inlets in the high-pressure air cylinder as well as in the low-pressure cylinder, and it is obvious that its theoretical capacity should include a high-pressure air cylinder full of free air as well as a low-pressure cylinder full on each stroke of the low-pressure piston. Those who are familiar with the operation of the New York No. 5 Duplex have observed that the high-pressure piston is at rest, while the low-pressure is in operation and vice versa, and as the high-pressure piston compresses the air delivered by the low-pressure piston, the low pressure is at rest and the space vacated by the movement of the high-pressure piston which would otherwise contain a partial vacuum is supplied by an additional air inlet, therefore, two cylinders full of free air should be compressed on each stroke of the low-pressure cylinder and the calculation should be made accordingly.

By capacity we mean the amount or volume of free air the pump can receive in a specified length of time, and naturally the volume it can receive depends in a measure upon the amount that can be compressed and driven from the cylinder, and when speaking of pump capacity we refer to a pump in good condition.

The following table will show the volume of free air that can escape per minute from the various sized openings under different pressures per square inch, whereby the efficiency of the pump can be determined when operated with any steam pressure that may be obtainable.

We can recommend this for a simple and convenient, as well as an accurate shop test for repaired air pumps, the table will show the number of cubic feet of free air each opening can expand from different air pressures, and when the pump is being operated at the maximum speed obtainable with a low steam pressure, or at a certain number of strokes per minute from a high steam pressure, the figures at which pump can maintain a certain pressure against a certain sized opening will determine its efficiency.

This test may be considered unnecessary as the average repairman feels that when he has completed the work of overhauling an air pump that no improvement can be made, however the condition of an air pump that has been removed for repairs may be questioned and this efficiency test of working the pump against an opening of known size will quickly demonstrate its state of efficiency and avoid any argument.

Supervision of Air Brakes.

The supervisor of air brakes on the modern railroad fills a much more important position than it is sometimes considered to be. Not only are there a greater variety of more complex brake equipments in use at the present day, but methods of repair work and maintenance have been improved upon to such an extent that in order for anyone to keep in touch with the best and most economical methods of shop work he must visit different places and note how the ideas of others have worked out.

There is absolutely no reason in anyone becoming imbued with the idea that his own methods and opinions are all that is necessary to insure the most successful and economical operation of a repair shop, but if various methods of repair work are observed it leaves the observer a choice of what he may consider the best practices Furthermore, when air brake work is given to the personal direction of men who never consult with air brake men and who have very little time to devote to it, the best possible results cannot be expected, as work that can be done in an economical manner at one point cannot always be done so at another, and one workman may consider a certain piece of repair work economical, while another might consider it more profitable or possibly more convenient to throw the parts in question into the scrap pile.

The supervisor is in position to know what can be done to the best advantage and can decide to what extent repair work can be carried out, and furthermore is in position to know what should not be done or even attempted in enginehouse or car yard work.

When a railroad has no supervisor or anyone visiting the various shops with a view of ascertaining air brake conditions, we know at once that harmonious and systematic methods of repair work are not in vogue on that railroad, because no matter how brilliant or able the master mechanics or general foremen may be they cannot devote sufficient time to the air brake business to go into the detail parts, and if everything is left to the discretion of the workman a variety of systems of maintenance are sure to result.

As to the profitable employment of an air brake supervisor, he can easily save a large railroad a sum of money that will double his salary in the ordering, caring for, and properly distributing material for repair parts alone, to say nothing of plugging some of the larger leaks which run into thousands of dollars annually.

Good Cooling Mixture for Hot Pins.

Take one bar of yellow soap and one pint of valve oil. Melt the soap in the valve oil, after which mix in two lbs. of clean white lead and stir well. If pin is very hot, remove the feeder from the cup and put a small quantity of the mixture down on the pin, after which replace the feeder or cup as the case may be and fill the cup to about one-quarter with the compound and the balance with engine oil. The quantity which reaches the pin direct will glaze the rubbing surface over, and that which is put into the cup itself will make oil about the proper specific gravity, to stand the additional heat in the metal. If the proportions given make the compound too thick or too thin change by adding soap or oil.

Locomotive Boiler Explosion.

Thirty-two men were killed by the explosion of a passenger engine in the Southern Pacific shops at San Antonio, Tex., on March 18. The engine was being tested after undergoing repairs in the center of a group of shop buildings. No report of the exact cause of the explosion has been published, but it is generally believed that it was owing to the carelessness of some of those employed in testing the boiler. The locomotive was practically new, and as many men were employed in the vicinity of the explosion it is not surprising that besides those who were killed, some 50 others were injured. The loss will amount to more than $200,000. A remarkable feature of the explosion was the fact that while the boiler and portions of the engine were thrown a considerable distance, the driving wheels and axles were not disturbed.

Lectures on Lubrication.

Dr. P. H. Conradson, chief chemist of the Galena Signal Oil Co., has arranged to deliver a series of lectures at the Permanent Exhibition in the Karpen Building, Chicago, on the subject of Lubrication of Steam Engines, embracing particularly the lubrication of engines using superheated steam. The lectures will be delivered on April 10, 11, 12 and 13, and will be accompanied by practical demonstrations made possible by laboratory apparatus arranged by Mr. Conradson. A large attendance of railroad men may be expected, as the lecturer is an eminent authority on the subject.

All the magic recipes for polishing brass which used to be so popular have disappeared. When an old fireman was asked what had brought about the change, he replied: "U. S. Infallible Metal Polish, made by Geo. W. Hoffman, Indianapolis. That is cheaper and better than any dope we can make."

Electrical Department

Methods Used in Mounting Railway Motors.

Our last series of articles on the "Construction of a Modern Railway Motor" described the various parts of the motor and how they are assembled, and we now come to the consideration of the methods used in mounting a railway motor on the truck.

The first electric motors used, between the years 1879 and 1885, were mounted in the body of the car and connections were made to the driving wheels by belts or gears. It was not until 1886, when Frank J. Sprague ran a test car on the Thirty-fourth street branch of the New York elevated and in 1887 when he built the electric railway in Richmond, Va., that the railway motor was mounted along the lines of present day practice. On the test truck two motors were mounted each occupying the space between the axle and the center crosspiece. One side of each motor was fastened to the crosspiece, but not solidly, as springs were used to take up the shocks. The other side of each motor was supported on the axle, using a split bearing. On the Richmond road the front side of the motors, instead of being fastened to the crosspiece, was fastened to the car body with springs to take up the vibrations (a more complete description and drawings can be found in the September and October numbers, 1911).

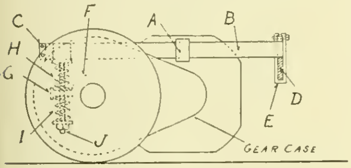


FIG. 1. CRADLE SUSPENSION.

It was only a few years after this that railway motors began to be used very extensively. Many unique schemes of mounting motors were brought out, but it was not until the cradle suspension was used that a satisfactory arrangement was found. Although this method is seldom used at present, we will describe same, as on some of the older cars using old style motors the method is still used. Other suspensions which can be found on old equipment will be considered, and we will then discuss the modern methods.

CRADLE SUSPENSION.

This type of suspension is shown by Fig. 1. On either end of the motor is cast a strap (A), through which are pushed the two ends of the U-shaped bar (B). The two ends of the bar are tied together at the back by the crosspiece (C), which is bolted to the U-shaped bar (B). The front of the bar (B) rests on a bar (D) running crosswise of the truck, both ends of which are bolted to the side frames of the truck, sometimes with springs intervening. The strap (E) ties the bar (B) to the cross-bar (D), but not solidly, so as to allow small movements. The motor is therefore held up in place as the back side is carried on the axle by the axle bearings (F), one on either end of the motor. To give more flexible suspension two lugs (G), one at either end of the motor, are provided, and springs (H) and (I) are placed on the top and bottom of the lug and the whole fastened to the U bar (B) by the bolt (J). Motion up and down of the back end of the U bar occurs and the motor is hung in a cradle, so to speak, hence the name "cradle suspension."

PARALLEL BAR SUSPENSION.

This method of suspension can be applied to the same motor as Fig. 1. Referring to this illustration a straight bar longer than one side of the U bar is placed through each of the two lugs (A), extending well beyond on both sides. The ends of each bar rest on the frame of the motor truck with spiral springs to cushion the vibrations. The back side of the motor is carried on the axle, but no connection by means of springs is made to the parallel bars.

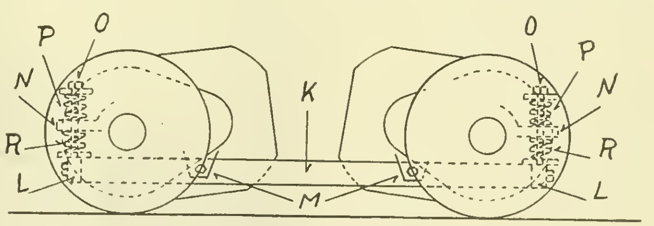


FIG. 2. GIBB'S SUSPENSION.

GIBBS' SUSPENSION.

Fig. 2 illustrates this form of motor suspension. Two side bars (K), one on either side of the motors, are joined together across the ends by the bars (L). The frame of each motor is fastened to the side bars at M. The back side of each motor is provided with a lug (N), which is fastened to the bar (L) by bolt (O) with springs (P) and (R) to take up the vibrations. Referring to the figure, it is seen that each motor serves as a support for holding up the other. Moreover, this arrangement is self-contained, and all of the weight is carried to the axles, as there are no connections between the side bars and the side frames of the truck. Two motors per truck are required with Gibbs' suspension, and each motor is not separately mounted, as in the previous suspensions. The arrangement gives a certain amount of freedom of movement to the motors, and less pounding occurs on the axles, but this method is not satisfactory, as many parts are required, and the cost of maintenance is very high. In overhauling it means practically dismantling both motors, which is a big disadvantage.

Before considering the modern methods of suspension, we will describe and point out the important parts of a modern railway motor truck. Fig 3 shows one of the latest trucks manufactured by the J. G. Brill Company. The truck consists of the side frames (1), which are tied together by the end frames (2), and the transom (3). Equalizer bars (4) and equalizer springs (5) are used. Between the sides of the transom (3), which are tied together by the transom tie bars (6), is located the bolster (7), on which is mounted the center bearing (8), and the side bearings (9). The bolster is carried on the bolster springs (10), so that same is free to move and the vibrations of the truck are not carried to the car body. Bolster chafing plates (11) and transom chafing plates (12) are fitted to the truck to receive the wear.

The bolster springs (10) rest in bolster spring seats (13), which are carried on the spring plank (14). This spring plank in turn is held up by the transom by means of the hangers (15).

CROSS-BAR SUSPENSION.

We now come to consider the modern methods of suspension, of which this is one. It is really a modification of the cradle suspension. Referring to Fig. 1, the straps (A) have been discarded, as

well as the U bar, and the cross bar (D) is bolted directly to the front of the motor frame on two machined surfaces provided for that purpose, one near either end. The cross bar is supported on the side frames of the truck. Referring to Fig. 3, the cross bar (16) is shown in position with the upper and lower suspension springs (17 and 18), for the purpose of preventing undue vibration of the motor, in place. The holes (19) in the cross bar receive the bolts which fasten the front of the motor frame to the bar. The back of the motor is carried on the axle by the axle bearings with no springs. Thus all of the springs and bars of the cradle, parallel bar and Gibbs' suspension are not used. It must be borne in mind that the motor of today is more compact and rugged than the motor of fifteen years ago, and they do not require as many springs to take up the vibrations.

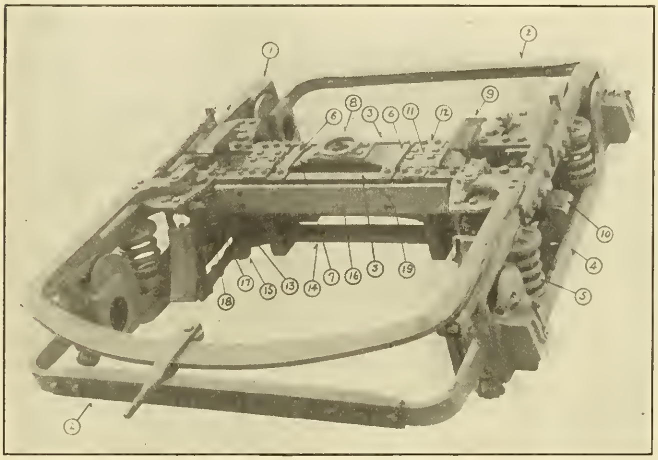


FIG. 3 A MOTOR TRUCK.

NOSE SUSPENSION.

The other modern method, besides the cross bar, for mounting the motor on the truck is what is known as the nose suspension. In this form a nose or lug is cast as part of the motor frame. This lug is located on the front side of the motor, near the top and in the center. The back side of the motor rests on the axle and the nose is of such length, usually about 8 ins. long, that it will rest on the transom. It is either bolted solidly to the transom, or springs are supplied and mounted on top and bottom of lug, the whole tied to the transom by a bolt. On large trucks with heavy truck springs there might not be flexibility enough for the motor in case the nose was bolted solidly to the transom.

We have described the various forms of suspensions, but there is another question to consider, that of the outside and inside hung motors, and what we mean by these terms.

INSIDE AND OUTSIDE HUNG MOTORS.

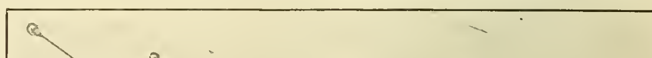
By an "inside hung" motor we mean that the motor occupies the space between the axles and the transom. Take the truck shown in Fig. 3 and the motors hung on this truck would be inside hung motors. That is, the wheel base of the truck is of such length that there is room for the motors to occupy this position. In city service many of the trucks have very short wheel base, as the sharp curves require this type, and the wheel base is such that there is no room for the motor to be hung between the axle and the transom. It is necessary, therefore, to hang the motor outside of the axle, hence the name "outside hung." To provide for supporting the front of the motor (the back side is carried on the axle by the axle bearings), the end frames are extended and the cross bar (16), Fig. 3, with suspension springs (17 and 18) will bear on the end frame.

British Columbia Electric Locomotives.

Our illustration shows a view of one of the two Baldwin-Westinghouse electric locomotives which have given much satisfactory service. The cab, truck and all mechanical parts were built by the Baldwin Locomotive Works. The electrical equipment was built and installed by the Westinghouse Electric and Manufacturing Company.

Each locomotive is equipped with four motors, one motor geared to each axle with a ration of 17:60.

The motors and auxiliary apparatus have sufficient capacity to enable the locomotive to exert continuously a tractive effort of 6,800 lbs. The locomotive is also able to exert a maximum tractive effort of 12,800 lbs. and maintain this up to a speed of 17.5 m. p. h. With clean, dry rails this T. E. can be increased to 20,000 lbs. and to 26,000 lbs. if sand is used. This tractive effort allows the locomotive to handle on straight, level track, 39 cars each weighing 45 tons. The principal dimensions of these locomotives are as follows: Rigid wheel base, 6 ft. 8 ins.; total wheel base, 22 ft. 2 ins.; distance between truck centers, 15 ft. 6 ins.; length over couplers, 31 ft. 1 in.; diameter driving wheels, 36 ins.; width, 9 ft. 6 ins.; height, 12 ft.; weight, 90,000 lbs. They are the first in British Columbia.



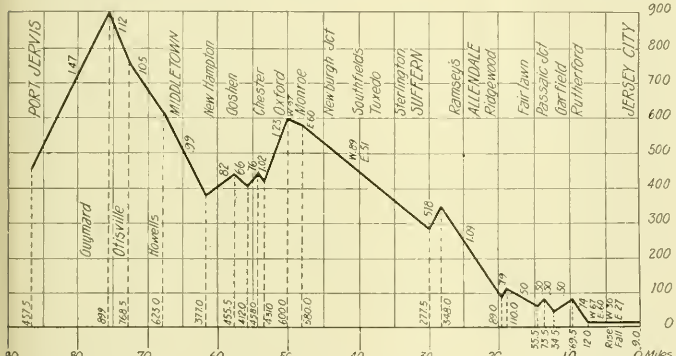
BRITISH COLUMBIA ELECTRIC LOCOMOTIVE.

Tests of the American Locomotive Co's. Fiftieth Thousand Locomotive

It will be recalled that we published in the February issue of RAILWAY AND LOCOMOTIVE ENGINEERING a general description of the American Locomotive Company's locomotive No. 50,000, a Pacific type, the total weight of engine and tender amounting to 430,500 lbs. The locomotive has undergone several months' service on the Erie Railroad, on the New York & Delaware divisions, and it has maintained schedule speed 96 per cent. of the time all winter from November 17 to February 25 in heavy fast passenger service with all that term today implies is a noteworthy locomotive record. It means that schedule speed or better was made on 163 runs out of 170 during the worst winter known for many years. For four months the train averaged 9 cars but frequently had 11 and 12. In the 170 runs, the locomotive made up 1,379 minutes, an average of 8 minutes per trip. On only seven runs was there any time lost by the locomotive which was not more than made up before the terminal was reached. On each of these occasions there were contributory causes for the delays for which the locomotive should not be held responsible.

Coupled with the particularly excellent showing made by the locomotive, when the demands on its power were greatest, this consistently satisfactory performance day in and day out, while not spectacular, indicates a sustained capacity sufficient not only to meet the ordinary requirements of modern fast passenger service, but also with a large margin to perform the unexpected service. It furnishes additional proof to that already given by service tests that locomotive No. 50,000 provides a capacity which has been obtained in few if any locomotives of equal weight and endurance. During the coldest days in January, from the 5th to the 8th, it made up a total of 120 minutes in 8 runs, an average of 15 minutes per trip with a train averaging 9 cars running between Jersey City and Susquehanna, 193 miles. Similarly, during the coldest weather in February, from the 5th to the 10th, it bettered the scheduled time by an average of 10 minutes for each of 12 runs, making up a total of 121 minutes during the period and lost but 6 minutes. In November and December the locomotive was making daily round trips between Jersey City and Port Jervis, but at the beginning of January the run was extended through to Susquehanna, the locomotive for the most part leaving Jersey City on train 5 and returning on train 6, with an hour and a half lay over at the Western terminal.

The long heavy grades encountered in both directions on the New York and Delaware divisions are shown in the accompanying profile. Sharp curves are also numerous. The schedule is 35 miles an hour including frequent stops. A rule of the road rigidly enforced limits the speed to 60 miles an hour.



CONDENSED PROFILE OF ERIE R. R., JERSEY CITY, N. J., TO PORT JERVIS, N. Y.

During the latter part of February a dynamometer test of the locomotive was made by the mechanical department of the Erie. The results of this test, which will be published in an early issue, will be of much interest as completing the tests of this new and powerful locomotive.

Boilers at Canadian Club.

At a recent meeting of the Canadian Railway Club Mr. J. W. Harkom sends a paper on locomotive boilers, in which he outlines the development of boilers since the time that the shell was 50 ins., grate area 18 sq. ft. and steam pressure 140 lbs. to the square inch. He referred to the troubles from cracked side sheets which were largely due to impurities in the early steel and gave the United States the credit for introducing steel boilers. In this he was corrected by Mr. A. A. Mayer, who stated that the first steel boiler used in railway service was made by Mr. Richard Eaton, at Hamilton, Ont., and had been illustrated in LOCOMOTIVE ENGINEERING.

Mr. Harkom dwelt at some length about staybolt troubles, and the attempts to find a remedy which had not yet been successful. Attempts have been made and we are told with some success to ameliorate the conditions by particular shapes and styles of staybolts, but the removal of the cause of trouble has not yet to any great extent been successfully made.

Staybolts broke where the angle of vibration was greatest, and the writer concluded that if the length of staybolts could be increased sufficiently to reduce the vibration on the inside, less breakage would be likely to occur.

In designing some fireboxes it was made imperative that a gradual increase in length should occur with every staybolt as it neared the O. G., and the length at that point was made as great as compatible with the general design and conditions.

The result was very satisfactory in the reduction of failures of staybolts, as confirmed very recently, after over five years' service.

One engine having this particular firebox, and repaired in January last, had only ten stay bolts renewed after a year's work.

The increase in water space afforded materially assisted the boilers as regarded priming, the behavior of those engines being good in a bad water district.

The foregoing principle was very strongly confirmed by Dr. Angus Sinclair at a meeting of the New York Railroad Club, when he said:

"The engineering world has striven for eighty years to restrain expansive forces of metal. They tried to resist the irresistible and to do so they made their sheets and staybolts heavier and heavier. There is an engineering aphorism that says, 'When an article breaks it is too weak,' but that does not apply to staybolts and side sheets of boilers, for the heavier you make them the more likely they are to break; and it seems now that the only remedy is to give flexibility instead of rigidity to these parts. This is a lesson to the whole railroad world—to be prepared to give flexibility instead of stability. I think, gentlemen, it is going to be one of the most important movements that has ever happened in the railroad world and is going to save untold trouble from leaky fireboxes and the terrific expense of continuously renewing a thing that appears to be just right

and goes to destruction apparently as soon as the work is done."

The firebox design of the American Locomotive Company's Mikado 5000, now running on the Erie Railroad, was commended and also the prolongation of the cylindrical form back over the firebox.

* * * * * * *

Some time ago the writer was consulted as to a boiler for which certain inspectors had on examination of the drawings reduced the intended working pressure.

The builders thought they had done just about all they could to get what they wanted, but on examination of the drawings the writer found there were too many rivets in the joint and that by leaving out half those on the outer rows of the joint (a buttstrap design) the pressure should be, and was later allowed.

The writer is not familiar with all that has been done in the endeavor to eliminate the troubles above referred to at some length, but his attention has been drawn to the claims of the W. H. Wood system of corrugating the sides and tops of fireboxes and the outer portions of tube sheets.

The performance of boilers of this description is said to be very good, and broken staybolts, also leaky tubes, practically eliminated.

That the effect of the transverse corrugations in firebox is to accommodate and so reduce its lengthwise expansion must to an observer be apparent.

The reduction in the number of staybolts to that necessary for staying the outside sheets only must be an advantage, also the length of what staybolts are needed is increased greatly.

A number of locomotives with the Wood fireboxes and sheets are in service on United States railways, and the writer has recently learned that one of the largest locomotives on the New York Central has been running successfully for over three years without broken staybolts, leaky mud ring or leaky tubes, its only boiler delays being retubing in October, 1910, and washout shop days, while other engines of the same class and service with fireboxes of similar dimensions have staybolts carying from 20 to 60 in number renewed each month.

This engine, No. 2490, is still in effective service.

It is claimed that the action of the corrugated surfaces cracks and throws off scale as indicated by the condition of the sheets after service.

Another type of corrugated firebox is being offered in which the corrugations are duplicated on the outside box or casing and no *staybolts* said to be used.

The boxes are made up of separate units for each corrugation, and apparently riveted together, the flanges of inside box being in water space and of necessity offering obstacles to circulation and opportunities for collection of mud or scale.

The movement due to expansion is not likely to free those flanges from scale as noted in the Wood type of box.

The flanges connecting the corrugated scaling of the outer box or casing do not offer at first sight an inviting surface for attaching the ordinary equipment of locomotives at that point, and it is rather doubtful if the flanges referred to offer sufficiently suitable opportunities or strength without impairing the joints to do so.

The paper was discussed at considerable length by the members present.

Business Prospects.

When railway supply men and others having similar interests meet to discuss business the trend of opinion expressed is that business is very bad, indeed; yet Bulletin No. 10 recently issued by the Railway Business Association describes the outlook for business as being highly encouraging.

The preface to Bulletin No. 10, signed by George A. Post, president, whose word is equal to his bond, says:

"If the shippers are to have railway facilities commensurate with the fabulous increase of tonnage for which they are demanding transportation, there must be expended during the half decade, 1911-1915, over three and a half billion dollars for additions and five billion dollars to maintain the plant as it existed at the end of 1910. Three and a half billions will be needed to provide the necessary increase in locomotive and car equipment, main and yard track and sidings, terminal facilities and taxes, and return on new securities. Five billions will be needed for replacements.

"Amazing as this statement may seem, it is, in fact, conservative, as will be apparent by a perusal of the contents of this bulletin issued by direction of the General Executive Committee of the Railway Business Association, after a comprehensive survey of the situation.

"There are only two ways in which railways can secure the money they ought to spend in the public interest. They must earn it or raise it by sale of new securities. Of course, they cannot spend eight and one-half billion dollars in five years and take it all out of earnings.

"Unless the railways can earn the millions that may be immediately applicable to improvements with the other millions to pay satisfactory returns to the investors in their securities, their credit will be impaired and they cannot get the money required to be spent properly to serve their patrons. The railways must be permitted to earn adequate revenue wherewith to meet the demands upon their resources.

"To protect the revenue of the railways, so that its volume will warrant them in making the outlay to keep pace with the growth of the country, is a duty the public owes to itself. It should make known to its servants clearly and forcibly that railway expansion and not railway restriction will be the yardstick by which their wisdom and usefulness will be measured.

"This bulletin is not a plea for the railroads. It is a plea for a rational consideration of the necessities of American business.

"What will it mean if our railroads shall during the current five years spend over eight and one-half billion dollars for the purposes named? The railways are the largest purchaser of labor and commodies. Manufacture and trade have not yet resumed in a vigorous way the movement of expansion which was interrupted in 1907. Many competent observers attribute this hesitation in the main to the hand-to-mouth policy which circumstances have imposed upon the railways. If the railways shall be placed in a position to undertake vigorous preparation for the future their activities will not only equip them to carry the increased tonnage, but will itself be a most powerful factor in bringing about a resumption of general business extension and construction.

"There is not a merchant who would not feel the quickening impulse in his business. There is not a wage earner who would not have a better-fed and clothed family. There is not a manufacturer whose factory would not be made a scene of activity wherein the glow of furnace fires would tell a story of prosperity, making glad the hearts of all who toil. There is not a farmer who would not have a greater demand for his produce.

"Before the shippers of the country the Railway Business Association lays the facts. What is to our interest as manufacturers of railway supplies in this vital matter is to the shipper's interest. Every shipper is directly and deeply concerned in studying the danger, seeking the cause and co-operating for its removal."

Removal.

The Pressed Steel Car Company, Western Steel Car & Foundry Company announce the removal of their St. Louis office to 14th floor, Old Colony Building, Chicago, Ill.

Items of Personal Interest

Mr. A. J. Roberts has been appointed locomotive foreman of the Grand Trunk Pacific at Regina, Man.

Mr. Peter Vosen has been appointed assistant master mechanic of the Wabash, with office at Decatur, Ill.

Mr. J. Kyle has been appointed master mechanic of the Canadian Northern, with office at Edmonton, Alberta.

Mr. S. J. Fero has been appointed master mechanic of the Great Northern, with office at Breckenridge, Minn.

Mr. G. H. Hedge has been appointed master mechanic of the Canadian Northern, with office at Winnipeg, Man.

Mr. W. H. Wenke has been appointed day engine house foreman of the Chicago, Rock Island at Cedar Rapids, Iowa.

Mr. L. F. Couch has been appointed master mechanic of the Memphis, Dallas & Gulf, with office at Nashville, Ark.

Mr. A. Shields has been appointed general master mechanic of the Canadian Northern, with office at Winnipeg, Man.

Mr. W. J. Eddy has been appointed inspector of tools and machinery of the Rock Island Lines, with office at Chicago.

Mr. Charles Powers has been appointed locomotive inspector of the Canadian Pacific, with headquarters at Montreal, Can.

Mr. J. T. Wallis has been appointed general superintendent of motive power of the Pennsylvania, with headquarters at Altoona, Pa.

Mr. W. H. Morse has been appointed locomotive superintendent of the Northwestern Railway of Peru, with office at Huasho, Peru.

Mr. C. D. Minard has been appointed master mechanic of the Iowa & Illinois, with office at Clinton, Ia., succeeding Mr. J. F. Greenleaf.

Mr. E. Robertson has been appointed road foreman of equipment of the Chicago, Rock Island & Pacific, with headquarters at Pratt, Kan.

Mr. J. A. Gibson, formerly master mechanic on the Big Four, is now superintendent of steam plants on the lines of the Illinois Traction System.

Mr. C. H. Sisler has been appointed division master mechanic of the Baltimore & Ohio at Cumberland, Md., in place of Mr. G. F. Weiseckel resigned.

Mr. John Pontius, road foreman of engines of the Pennsylvania Lines west at Columbus, Ohio, has been appointed general inspector of engines at Columbus.

Mr. Willard Kells has been appointed assistant to the general superintendent of motive power of the Atlantic Coast Line, with office at Wilmington, N. C.

Mr. H. W. Wheatcley has been appointed road foreman of engines of the Grand Trunk, with office at Montreal, Que. He succeeds Mr. F. Fayette.

Mr. C. K. Stewart has been appointed master mechanic of the Missouri Pacific, with headquarters at Coffeyville, Kan., in place of Mr. T. M. Vickers, resigned.

Mr. F. A. Neale has been appointed general foreman of the Central Railroad of New Jersey, and succeeds Mr. E. A. Detro, with office at Jersey City, N. J.

Mr. Edward Thomas has been appointed division foreman of the Oregon-Washington Railroad and Navigation Company, with office at La Grande, Ore.

Mr. E. F. Hughes has been appointed traveling engineer on the Reid Newfoundland Company, covering the territory between St. John's, N. B., and Clarenville.

Mr. Arthur Herrick has been appointed master mechanic of the Mississippi Hill City and Western, with office at Hill City, Minn., succeeding Mr. B. B. H. Johnson.

Mr. E. J. Searles, formerly assistant general superintendent of motive power of the Baltimore and Ohio, has been promoted to superintendent of motive power at Pittsburgh, Pa.

Mr. Charles Bowers, formerly engine house foreman of the Minneapolis, St. Paul and Sault Ste. Marie, has been promoted to engine house and shop foreman at Fond du Lac, Wis.

Mr. C. W. Abrams, assistant general foreman of the Missouri Pacific at Little Rock, Ark., has been appointed general directing foreman, and the office of assistant has been abolished.

Mr. F. E. Cannon, master mechanic of the Lake district of the Great Northern at Superior, Wis., has been appointed general master mechanic of the Lake district, with office at Superior.

Mr. J. E. Gould, superintendent of motive power of the Norfolk Southern, with office at Berkeley, Va., has also been appointed to the same position on the Raleigh, Charlotte and Southern.

Mr. George Langton has been appointed master mechanic of the Texas & Pacific, with office at Marshall, Tex., in place of Mr. O. A. Clarke, who has been transferred to Dallas, Tex.

Mr. C. E. McLaughlin, master mechanic of the Great Northern Railway, at Breckenridge, Minn., has been appointed superintendent of the Dakota division, with headquarters at Grand Forks, N. D.

Mr. James Weir has been appointed district locomotive boiler inspector at Louisville, Ky. He was formerly an engineer in the employ of the Michigan Central, and has an excellent record.

Mr. H. E. Passmore, division master mechanic of the Toledo and Ohio Central at Kenton, Ohio, has been appointed master mechanic of the same road and the Zanesville and Western at Bucyrus, Ohio.

Mr. W. H. Erskine, assistant master mechanic of the Minneapolis and St. Louis at Minneapolis, Minn., has been appointed master mechanic over the Central and Western divisions, with office at Cedar Lake, Minn.

Mr. G. E. Kellar, formerly chief clerk to the mechanical superintendent on the Erie at Jersey City, has been appointed assistant chief clerk to the general mechanical superintendent of the same road at New York.

Mr. W. A. Cotton, formerly chief clerk to the mechanical superintendent of the Erie at Cleveland, Ohio, has been promoted to chief clerk to the general mechanical superintendent at New York, on the same road.

Mr. F. M. Gilmore, formerly with the Railroad Department of the H. W. Johns-Manville Company, has accepted a position with the Chicago Car Heating Company, with headquarters in Railway Exchange Building, Chicago.

Mr. D. C. Boy is engaged in the establishment on the Central of Georgia Railway of an educational bureau for the benefit of its employees. The bureau will be similar to that in vogue on the Union Pacific and Illinois Central lines.

Mr. T. E. Cannon, formerly master mechanic of the Lake district of the Great Northern at Superior, Wis., has been appointed general master mechanic of the Lake district, with office at Superior. Mr. B. E. Asgard succeeds Mr. Cannon.

Mr. J. T. Luscombe, division master mechanic of the Toledo and Ohio Central and the Zanesville and Western at Bucyrus, Ohio, has been appointed master mechanic of the Cleveland, Cincinnati and St. Louis, with office at Bellefontaine, Ohio.

Mr. F. J. Zerbee, formerly master mechanic of the Cleveland, Cincinnati, Chicago & St. Louis at Bellefontaine, Ind., has been appointed superintendent in charge of Federal and State in-

spection and safety appliances on locomotives and cars, with headquarters at Indianapolis, Ind.

The L. S. Starrett Company was incorporated in 1900, succeeding to the business established by Mr. L. S. Starrett in 1880 and conducted by him individually up to the time of its incorporation. Mr. L. S. Starrett continues in active control of the business.

Mr. C. A. Delaney, a number of years superintendent of the Dickson Works of the American Locomotive Company at Scranton, Pa., and later sales representative at that place, has just been appointed Western representative with headquarters in the McCormick Building, Chicago.

When Percy R. Todd, vice-president of the Bangor & Aroostook, was a boy, he was sent to work in a lawyer's office in Ottawa, Ont. After being three days in the office he came home one evening and declared to his mother that he was sorry at having learned the law business, for there was nothing in it.

Mr. O. S. Beyer, Jr., who has been for several years an engineer's assistant in the office of the superintendent of motive power of the Erie Railroad, has accepted a position in the mechanical department of the Chicago, Rock Island & Pacific Railway. Mr. Beyer is a graduate of Stevens Institute of Technology, and has been an earnest student of railroad engineering problems.

Mr. W. J. Eddy, who has been for some years general locomotive inspector of the Erie Railroad, at Meadville, Pa., has accepted the position of machine inspector with the Rock Island lines at Chicago. Mr. Eddy served a machinist apprenticeship in a railroad repair shop in Oklahoma and then went through the engineering course at Purdue University. He has made a special study of machine tools and is well informed on the line of his future work.

The election of officers of the Galena-Signal Oil Company occurred last month and the following are announced as the officers for 1912: Chairman of the Board, Gen. Charles Miller; president and general manager, Mr. S. A. Megeath; vice-president, Mr. C. C. Steinbrenner; second vice-president, Mr. E. H. Baker; treasurer, Mr. E. H. Sibley; secretary, Mr. J. French Miller; assistant secretary, Mr. G. F. Proudfoot. The main offices are at Franklin, Pa.

Mr. W. J. Crandall has been appointed master mechanic of the Rochester division of the New York Central, with office at Rochester, N. Y., in place of Mr. W. P. Carroll, who has been transferred to the Mohawk division, with office at West Albany, N Y., and Mr. S. J. Delaney has been appointed assistant master mechanic at the same place. Mr. M. H. Strauss is also appointed master mechanic of the River division of the same road, with office at New Durham, N. Y., in place of Mr. G. H. Eck.

Mr. L. R. Laizure, recently appointed master mechanic of the Erie at Hornell, N. Y., announces the following changes and promotions in his staff there: Mr. Denis R. Horrigan, transferred from pipe fitter to foreman tin, pipe and copper department, vice Mr. J. Griffith, resigned. Mr. L. Smith, transferred from foreman of tank shop to foreman erecting shop, vice Mr. H. G. Overby, resigned. Mr. L. E. Van Antwerp, transferred from carpenter to foreman of tank shop.

We have received from Mr. James Cran, Art smith, Plainfield, N. J., some specimens of artistic blacksmithing that are the finest we have ever seen. One represents a Scot's thistle with the leaves and flower as finely worked out as they are in nature. In medieval times, when blacksmiths did wonderfully fine work on armor, these artisans were in the habit of forging imitations of flowers and many fine specimens are still to be seen in European museums. The writer has examined many of these triumphs of the blacksmith's art, but he never saw any specimen that was finer than the work done by Mr. Cran.

C. C. OWENS.

Mr. C. C. Owens has recently been placed in charge of the Detroit District of the Westinghouse Electric and Manufacturing Company's sales office with the title of district manager. Mr. Owens was born in 1877 near Annapolis, Md., and graduated from Columbian University, Washington, D. C., with the degree of Bachelor of Science in electrical engineering. He entered the employ of the company in 1896, taking the apprenticeship course for three years, after which he spent four years in the Engineering Department, specializing on switchboards and controllers. For the last eight years he has been connected with the New York sales office having had charge of the Industrial and Power Division for the two previous years to his transfer to Detroit.

The officers of the L. S. Starrett Company for 1912 are: Mr. L. S. Starrett, president; Mr. F. A. Ball, vice-president; Mr. F. E. Wing, treasurer and secretary; Mr. W. G. Nims, assistant treasurer; with a board of nine directors consisting of the officers named and Mr. M. B. Waterman, Mr. Augustus P. Loring, Mr. John A. McGregor, Mr. J. H. Drury, and Mr. W. B. McSkimmon. The last four named are officers of the Union Twist Drill Co., the second largest machine factory in Athol. The Union Twist Drill Company becomes a stockholder of the L. S. Starrett Company and as such has representation on the Board of Directors, which is increased from five to nine.

Mr. E. T. Jeffery, President of the Denver & Rio Grand Railroad, has a phenomenally retentive memory. Mr. Jeffery rose through the mechanical department, having been a machinist, draughtsman and assistant superintendent of motive power of the Illinois Central before rising to be general manager of the same road. As draughtsman it was said that he could make drawings of a locomotive and fill in dimensions from memory. When suits were brought against the Illinois Central by the State of Illinois, Mr. Jeffery was the principal witness in defending the company's rights to the lake front and his evidence was given entirely without notes. When he first became general superintendent of the road, Mr. Jeffery accompanied the engineer of bridges on an inspection tour, all the bridges having been carefully examined. During subsequent consultations about what should be done to certain of the bridges, Mr. Jeffrey proved that he remembered the identity and particulars of construction of every bridge they had examined. Although he has been for many years a railroad president, he has not ceased to interest himself in engineering.

Obituary.

ROBERT F. McKENNA.

We regret to announce the death of Mr. Robert Fergus McKenna, former master car builder of the Lackawanna Railroad, at the comparatively early age of forty-three years. The sad event occurred early last month at the University of Pennsylvania at Philadelphia where he had been operated upon. He was for many years one of the best known railroad men in Scranton, Pa., and had occupied many prominent positions in railroad and other societies. His father had for many years been occupied as master car builder of the Lackawanna at Scranton, and his son had had a thorough training in pattern making and car building, and was rapidly advanced from rank to rank, and finally occupied his father's position. A large concourse, chiefly members of social and other societies, attended the funeral. The interment was in Dunmore. Pa.

Scientific Management.

At a recent meeting of the Franklin Institute in Philadelphia, Mr. W. E. Symons read a paper on "The Practical Application of Scientific Management in Railway Operations." In the discussion that followed, Angus Sinclair, Editor, Railway and Locomotive Engineering, said:

It appears strange to me in this day and generation, when the production in every line of industry has been vastly increased by labor-saving machinery, that a clamor should have arisen to provide means for increasing beyond reason the output of the workman's manual skill and labor. Production of finished goods has increased so rapidly of late years that the demand of the people has not kept pace with the supply, and the whole world seems to be suffering from overproduction.

When viewed in its broadest sense, overproduction only means underconsumption; but production has increased so rapidly during the last decade that there is no time for natural adjustment. That being admitted to be the case, it is not a proper time to urge greater efforts for production upon the workman.

The assumption of the people promoting scientific management of production is that the ordinary workman is constantly trying to do as little labor as possible in return for the wages paid by the employer. I spent some ten or twelve years as a shop mechanic, and I was for about five years a shop foreman, besides spending several years visiting manufacturing establishments and railway rolling stock repair shops, for the purpose of writing about the work going on; so I have enjoyed good opportunities for judging the habits of workmen. Some men are lazy, permanently tired, and they do as little work as they possibly can, but the great mass of workmen are naturally industrious and ready to do a fair day's work. There is an individuality among the workmen that enables some men to do much more work than others with the same degree of effort; but it is the kind of individuality that enables one stenographer to write much faster than another person engaged in the same business; the want of quickness ought not to be blamed upon the person as lack of industry.

I am familiar with the work carried on in nearly all the leading railway repair shops in Europe, in this country, in Canada, and in Mexico, and I feel safe in asserting that when left to his own volition the American workman accomplishes from 10 per cent. to 25 per cent. more than any other mechanic.

Nearly all mechanics work on the principle of giving a fair day's work for a fair day's wages. In British shops there is very little inclination among those in charge to push workmen beyond their working gait, and it is generally considered rude to find fault with a man who is working steadily.

I had personal experience in the first shop I worked in in this country that gave me a striking impression of the shop etiquette here, as compared with that I had been accustomed to in Scotland. I had been given a job which involved much chipping and filing, and went at it on the same speed I had been accustomed to work. When I had been working about three days, the shop superintendent stopped and watched me for a few minutes and remarked, "You know how to chip, but you're taking a hell of a time over the job. Remember, you are not in Scotland now." He was a Scot himself.

I have been watching the operation of Scientific Management, and I believe its tendency will be to take away the pride a mechanic has in doing his work—a thing to be sadly deplored. There has been so much sentiment manifested of late years to work machine tools up to their highest capacity that a similar sentiment seems to be extended to the man who is regarded as a mere animated machine, deserving no more consideration as a producer than the working parts of an automatic tool.

Another thing about the Scientific Management which I dislike is the idea of having the workman constantly under a sort of tutorage, his every movement being supervised. It seems to me that human nature will resent such humiliating conditions.

I agree with Mr. Symons that it may be practicable to introduce Scientific Management to new work, but I fail to see how repair work can be done by that system. Those supervising piece work in repair shops, have great difficulty in arranging equitable pay for certain jobs, for it is often almost impossible to estimate the time that a good mechanic will require to do the work. Repair shopmechanics are specialists in their line. Under Scientific Management the inclination is taken away from the workman and taken up by the management. The management would need to consist of very skilful and experienced mechanics to decide in which way a difficult repair job should be executed. According to my judgment, the system would confuse the workmen without reflecting any glory on the management.

International Railway General Foremen's Association.

As previously announced in Railway and Locomotive Engineering the General Foremen's Association will hold their next annual convention in Chicago, at the Hotel Sherman, July 23 to 26, 1912, inclusive, with the following papers as subjects.

No. 1.—How can shop foremen best promote efficiency, continuation paper No. 1 of 1910 convention by Wm. G. Reyer, general foreman, N. C. & St. L, Nashville, Tenn.

No. 2.—Shop Supervision and Local Conditions, W. W. Scott, superintendent shops, P. M., Saginaw, Mich.

No. 3.—Shop Specialization Work and Tools, W. T. Gale, demonstrator, C. & N. W., Chicago.

No. 4.—Round House Efficiency, Wm. Hall, general foreman, C. & N. W. Railway, Escanaba, Mich.

Special Paper No. 1.—Reclaiming of Scrap, by C. H. Voges, general foreman, Big Four, Bellefontaine, Ohio, and C. Ogden, general foreman, A. T. & S. F., Las Vegas, New Mexico.

Special Paper No. 2.—The Relation of Tests to Shop Efficiency, by J. S. Sheafe, engineer of tests, and L. A. North, general foreman, Illinois Central, Chicago.

As will be noted the subjects are all of importance, and much that will be of real value will be presented by the members contributing papers. A large attendance is already assured, and the continuance of applications for membership indicate a large increase during the year. Mr. W. T. Gale, 50 North Waller avenue, Austin, Chicago, is chairman of the Membership Committee. The officers are: President, F. C. Pickard, C. H. & D. Railroad, Indianapolis, Ind.; first vice-president. J. A. Boyden, general foreman, Erie Railroad, Hornell, N. Y.; second vice-president, T. F. Griffin, general foreman, C. C. C. & St. L. Railroad, Indianapolis, Ind.; third vice-president, W. Smith, foreman, C. & N. W. Railroad, Fremont, Neb.; fourth vice-president, L. A. North, general foreman, I. C. Railroad, Chicago, Ill.; Wm. Hall, secretary, M. S. foreman, C. & N. W. Railroad, Escanaba, Mich.

No Engineers' Strike.

On January 22 W. S. Stone, grand chief of the Brotherhood of Locomotive Engineers, acting on behalf of the locomotive engineers of fifty railroads east of Chicago, asked for a raise of pay amounting to 18.63 per cent. A committee of the General Managers and Vice-presidents was appointed to represent the railroads, and John C. Stuart, of the Erie, was chairman. Through Mr. Stuart an answer was given to Mr. Stone refusing to grant the request of the engineers. The plea of the railroad companies is that it is impracticable to grant the raise of pay because the income of the roads is not sufficient to bear the additional cost.

This has given rise to alarming rumors about an impending strike of locomotive engineers, but Mr. Stone explained that it took a two-thirds vote of the men interested to cause a strike and that should the men vote to strike it could be vetoed by him. Most of the strike talk is among reporters and outside gossip.

Gold's Ideal Pressure Regulator.

A new and valuable addition has just been made to the fine products of the Gold Car Heating & Lighting Company, Whitehall Building, New York. It consists of a pressure regulator, and is formed primarily of two main parts comprising a small controlling valve and diaphragm in the upper left half of the regulator, and a large main supply valve and diaphragm in the lower half. Fig. 1 is a photographic reproduction of the new pressure regulator, and the operation of the device will be readily understood by reference to Fig. 2, which shows a sectional view of the details of the device.

By screwing down handle W until spring V is sufficiently compressed to allow the required and predetermined delivery pressure to be furnished at the outlet side of regulator (left hand side), the controlling valve is opened. Steam at boiler pressure comes into the inlet side of regulator (right hand side) and passes up through the small passage to the space under bottom of the controlling valve and through the open valve to a small annular groove above valve and thence through a small connecting passage (shown in dotted lines) downward to the space above the large diaphragm Q. The pressure exerted on this diaphragm presses it downward, opening the main supply valve, thereby admitting a flow of high pressure steam from the inlet to the outlet side of the regulator, the steam at the same time passing upward, through an opening provided, into chamber under main diaphragm Q, and also upward through small passage into the chamber under the controlling diaphragm R, presses against these diaphragms until it just balances the pressure exerted on their upper sides. If the draft on the steam on the low pressure side of the regulator is increased, it tends to reduce the pressure there. This reduction of pressure is at once transmitted to the under side of the controlling diaphragm R and the fixed compression in the spring V at once causes this diaphragm to depress and the controlling valve is opened, thereby allowing high pressure steam to pass through this valve to the top of the main diaphragm Q producing a further opening of the main supply valve and an immediate increase of the supply of high pressure steam directly to the low pressure side of the regulator. If for any reason the supply or boiler pressure is reduced, the resultant pressure on the outlet or train supply side of regulator would be momentarily slightly reduced and the consequent pressure in chamber under the controlling diaphragm R would be lessened and at once the controlling valve would open slightly, thereby in its turn causing the main supply valve to open farther and give the added volume and pressure from the boiler supply side necessary to keep the train supply side up to the predetermined pressure.

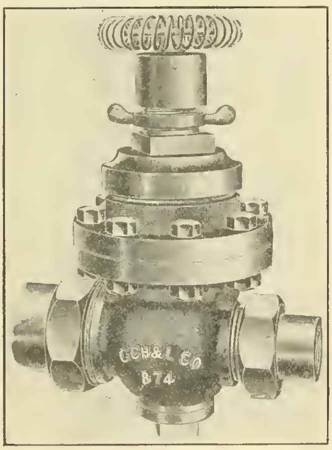


FIG. 1. GOLD'S PRESSURE REGULATOR.

If, from any cause, the pressure on the train supply side of regulator is increased, as might be produced by a reduction of number of cars to be supplied with steam, the increased resultant pressure on the under side of the main diaphragm Q would at once cause main valve to close and at the same time this increased pressure under the controlling diaphragm R would hold the controlling valve tightly closed until such time as the pressure on the train supply side of regulator was reduced to a point below the predetermined train supply pressure. The controlling valve will always be closed when the train supply pressure reaches the predetermined amount, and will at once be opened automatically when it reduces below this amount. In case of any small leakage of steam through the controlling valve to the space above the large diaphragm, such leakage will pass through the small leakage plug opening at Z into the train supply side of the regulator, thereby causing no opening movement of the main supply valve.

The device has been thoroughly tested and the results have been that under the simplest and under the most severe and adverse conditions the new regulator delivered steam for the train supply pipe at an absolutely uniform and fixed predetermined pressure.

Joseph T. Ryerson & Son have opened a district office in Detroit, Mich, and have also removed their office at Minneapolis, Minn., to a corner ground, store floor for the better display of their steel, machine tools and specialties. The company is one of the oldest in America, and continues to grow with the growing years. The chief office is at 16th and Rockwell streets, Chicago, Ill.

Wonders of a Drop of Water.

Figures are sometimes impressive simply by reason of being so stupendous that the human mind grasps them with difficulty, says the New York *Sun*. An instance in point is afforded by the illustration offered to his hearers by an eminent scientist, who, in order to bring to their comprehension the idea of ultimate particles of water, stated that if he was to empty a tumbler containing half a pint of water, letting out each second a number equal to 1,000 times the population of the earth, it would require somewhere between 7,000,000 and 46,000,000 years to empty the tumbler.

Lord Kelvin once assured us that if a drop of water was magnified to the size of the earth, the particles would be between the size of baseballs and footballs. If that statement is correct the drops of water in all the ocean are not many times so numerous as the particles or molecules in a single drop.

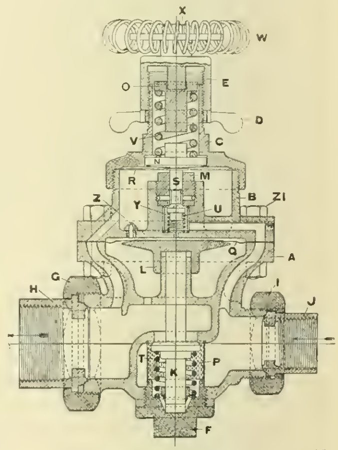


FIG. 2. SECTIONAL VIEW OF GOLD'S PRESSURE REGULATOR.

Reorganization.

The Vulcan Engineering Sales Company has been organized and incorporated with offices in the Fisher Bldg., Chicago, and 30 Church street, New York. The company controls the entire product and will handle all sales of the Hanna Engineering Works of Chicago, Mumford Molding Machine Company of Plainfield, N. J., and Q. M. S. Company, of New York. Further factory arrangements are under way and the Vulcan Company will own and manufacture a number of railway special tools and equipment for shop and maintenance departments.

The officers are F. K. Gilbert, president, formerly vice-president of the Buda Company, and P. W. Gates, secretary and treasurer, now president of Hanna Engineering Works, formerly president of Gates Iron Works.

Railroad Notes.

The Denver & Rio Grande R. R., it is reported, is in the market for 40 locomotives.

Z. Spinks, Espanola, Fla., is in the market for one small standard-guage locomotive.

The Norfolk & Western has ordered 6 Pacific type locomotives from the Baldwin Locomotive Works.

The Chicago Great Western has ordered 5 Mikado locomotives from the Baldwin Locomotive Works.

The International and Great Northern has ordered 10 Consolidation locomotives from the Baldwin Locomotive Works.

The Houston & Texas Central has ordered 33 locomotives from the company's shops. Work is already begun on the order.

The Texas Pacific has ordered 10 Consolidation locomotives and 10 passenger locomotives from the Baldwin Locomotive Works.

The Delaware, Lackawanna & Western has ordered 6 eight-wheel switching locomotives from the Lima Locomotive and Machine Works.

The Louisiana & Arkansas Railway has ordered two American type locomotives and two ten-wheel locomotives from the Baldwin Locomotive Works.

The Southern Pacific has ordered 15 Mogul locomotives, 10 Pacific locomotives and 8 six-wheel switching locomotives from the Baldwin Locomotive Works.

The Pittsburgh & Lake Erie has ordered 5 ten-wheel locomotives from the American Locomotive Company. These will be equipped with superheaters.

More than 4,500,000 freight cars are handled annually in Chicago, exclusive of traffic moving to and from the Union Stock Yards, and of this number 1,500,000 are interchanged.

The Atchison, Topeka & Santa Fe has ordered 25 Pacific type locomotives, 20 switching locomotives, 20 Santa Fe locomotives and 10 Consolidation locomotives from the Baldwin Locomotive Works.

The H. W. Johns-Manville Company, already well known in the lighting field by reason of their J-M Linolite system of illumination, have acquired the sole selling agency for the entire products of I. P. Frink reflectors and illuminating specialties.

Wherever the Tate stay bolt is used, leaky stay bolts is a trouble of the past. The Tate bolt has proved itself indispensable to locomotives in high pressure service. The use of that bolt is more convincing testimony to its high merit than anything that can be said or written.

Plans have been prepared by Henry Raeder, architect, and W. E. Wood, consulting engineer of Chicago, for a most attractive station building to be erected by the Chicago, Burlington & Quincy Railroad at Galesburg, Ill. When finished it will be one of the finest way stations in the West.

The Western Maryland Railway has ordered ten Pacific type locomotives from the Baldwin Locomotive Works, and 15 consolidation locomotives with 24 x 30-in. cylinders, driving wheels 60 ins. in diameter and a total weight of 237,000 lbs. in working order, from the American Locomotive Company.

It is announced that extensions to the Missouri, Oklahoma & Gulf, aggregating 300 miles, are to be started immediately. The road from Wagoner, Okla., to Joplin will be finished in November. Another line is to be built from Henrietta to Oklahoma City and an extension from Denison to Dallas and Fort Worth. The cost of the extension will be about $10,000,000.

The Philadelphia Rapid Transit Company and the International Railways Company, of Buffalo, N. Y., have awarded a contract to the Westinghouse Electric & Manufacturing Company for 500 complete car equipments. Each equipment consists of two No. 306-C box frame, interpole railway motors, rated at 50 h. p., 500-volts, type K-36 controllers and Westinghouse car type circuit-breakers.

Three new roads have just been incorporated in Mississippi, two of which are believed to have as their sponsor the New Orleans, Mobile & Chicago. The names of the companies are the Meridian & Deep-water, the Meridian & Memphis and the Natchez & Eastern. The first two have their rights of way already secured and agents are now engaged in getting that required by the last named.

Tenders have been requested by the Grand Trunk Railway Company for the construction of roadbed and buildings of the Southern New England Railway, which will bring the Grand Trunk Company from Palmore, Mass., to Halifax, N. S. The contracts call for completion of everything in connection with extension of the road on or before December 31, 1913. The company officials expect to have trains running over the new road before the end of the present year.

A feature of the educational work which the Pennsylvania Railroad is carrying on among its employees is the operation of the Signal Examination Car. This is continually moving from place to place in charge of an examiner who puts the men through tests designed to keep them at a high standard of competency. The car is equipped with miniature signals for the purpose of examining employees in their operation. Sight, sense of color, and hearing are also tested on entrance to the service and periodically thereafter.

The Delaware, Lackawanna & Western Railroad has ordered 15 Mikado locomotives and seven Pacific type locomotives from the American Locomotive Company. The Mikado locomotives will have 28 x 30-in. cylinders, driving wheels 63 ins. in diameter and a total weight of 314,000 lbs. in working order. The Pacific type locomotives will have 25 x 28-in. cylinders, driving wheels 63 ins. in diameter, a total weight of 281,000 lbs. in working order, and will be equipped with superheaters. The road has also ordered, from the Baldwin Locomotive Works, six transfer locomotives, weighing 200,000 lbs. in working order.

The Western Maryland Railroad has awarded a contract for the construction of fifteen consolidated locomotives to the American Locomotive Company and for the construction of ten Pacific type passenger locomotives to the Baldwin Locomotive Works. The St. Paul has bought fifty Pacific type locomotives from the American Locomotive Company, with which company it recently placed an order for ten engines of the Mallet type. The St. Paul is also in the market for an additional order of fifty locomotives of the Mikado type. Pittsburgh and Lake Erie has ordered five ten-wheel locomotives from the American Locomotive Company.

The Minister of Railways announces that on March 31, 1911, 2,761 miles of railway were open for traffic in New Zealand, as against 2,717 miles the previous year. The net earnings per average mile on lines open in 1911 were $2,114, as compared with $1,944 the previous year. The net earnings per train mile for the past year were 70 cents, as compared with 66 cents the previous year. In addition to $486,000 to be expended during the next four years on grade-reduction work alone on government railways, other contemplated large expenditures are covered in the loan bill which has passed the New Zealand Parliament providing authority for raising $2,430,000 for railway construction and $1,458,000 for additional rolling stock.

In the name of the Chamber of Commerce of Morelia, a number of citizens have petitioned the Minister of Communications and Public Works at Mexico City for the construction of the Michoacan Railroad. This enterprise is one of many promising activities which are awakening keen interest in this resourceful region. The proposed line will leave Uruapan and crossing the districts of Arie, Apatzingan, and touching at Inguaran, will have as its terminal point the important port of Zihuatanojo, likewise selected by the proposed railroad of the State of Guerrero. The estimated cost of the Michoacan Railroad is $5,300,000 American currency, but a Federal subvention of $6,250 per kilometer (0.62 mile) is sought. The region to be traversed is rich in virgin agricultural and mineral resources, and has streams suitable for irrigation.

The vastness of the Pennsylvania Railroad system and the number of people dependent upon it, is indicated in a report issued today, showing that on December 31, 1911, it had 25,236.5 miles of track, the greatest in the history of the company. The number of stockholders on March 1 was 73,567, showing an increase of 7,744 over last year. This does not include stockholders of the subsidiaries, nor does it embrace bondholders of the Pennsylvania Railroad Company and affiliated lines.

The system has 11,503.76 miles of lines of which 6,329.54 miles are east of Pittsburgh, and the remainder 5,174.22, west of Pittsburgh. These lines run through thirteen States and the District of Columbia in which live more than one-half of the people of the United States. The system has 11,503.76 miles of first track, 3,593.03 of second track, 789.41 of third track and 619.03 of fourth track. It has also 8,722.27 miles of sidings. The Pennsylvania is essentially an institution of the State of Pennsylvania, and in it are 4,134.07 of the 11,503.76 miles of line.

The American saying, "Never attempt to cross a bridge till you reach it," has a very ancient Scottish equivalent in "Never say hoos a wi' ye to the devil until you meet him."

Books, Bulletins and Catalogues

Forney's Catechism.

Forney's Catechism of the Locomotive, which has been out of print for some time, appears in a new edition. The work has been revised and enlarged by George A. Fowler, an eminent engineering authority, and so much that is new has been added to the work that it has been decided to extend the book to two volumes, making each complete in itself. The first part, now ready, is devoted to the practical construction and operation of the locomotive. The second part will take up the subject more theoretically, the whole forming a complete catechism of the details of modern locomotives. The second volume is expected to be issued at an early date. The Simmons-Boardman Publishing Company, New York, have spared no pains in preparing a handsome volume. The letterpress and illustrations are excellent. McGraw-Hill Book Company, New York, are the selling agents. The price is $3 each volume.

Standard Train Rule Examination.

A new edition, the eighth, of this book has just been issued, and is in many respects superior to the previous editions. Mr. G. E. Collingwood, the author, has long been recognized as an eminent authority on the subject, and the present edition has been carefully revised and enlarged by him and is almost twice the size of the previous edition. The most important change in the new edition is that each rule is explained in detail, whereas in former editions only a few of the rules were explained. All who are interested in the subject cannot do better than procure a copy of the new edition, even those who may have copies of the older editions will find so much that is new, and they need hardly be reminded that the author is universally recognized as the leading writer on this important subject. The price postpaid in fine leather binding is $2. Cloth binding, $1.50. Orders may be sent directly to G. F. Collingwood, Toledo, Ohio.

Signal Dictionary.

The Railway Signal Association Signal Dictionary has been revised and republished under the supervision of a committee of the association. The work is a handsome volume of 600 pages, and nearly 4,000 illustrations. It is published by the Simmons-Boardman Publishing Company, New York and Chicago. Price in leather binding, $6, cloth, $3.50. The work contains all of the standards adopted by the Railway Signal Association and also many standards of signal departments of prominent railways in this country and England. Mr. A. D. Cloud, editor of *The Signal Engineer*, has been assisted in the preparation of the work by Mr. H. H. Simmons, and the revised work may fairly be said to be the standard work on the subject.

Rating Locomotives.

"Rating Locomotives" is the title of a new book by Mr. H. Cole, district locomotive superintendent, Indian State Railways, and is published by W. Thacker & Co., Creed Lane, London, at $2.50 per copy. The purpose of the book is to present to railway officials a concise account of the general principles governing engine loads and train speeds, and of the present state of knowledge regarding the actual power developed by steam locomotives and the resistance to traction of rolling stock, under ordinary working conditions. The enormous importance of aiming for the highest practicable degree of locomotive efficiency is borne in mind throughout the book, and much that is of real value is contained in the work. A number of diagrams illustrate the results of many experiments under varying conditions.

Safety Heating and Lighting.

The perfection of detail of the fine products of the Safety Heating and Lighting Company, 2 Rector street, New York, is admirably presented in the current issue of the Safety Heating and Lighting News. This is a high-class 16-page periodical devoted to the thorough explanation of the company's apparatus for the heating and lighting of railroad cars. Among their more recent improvements is the Thermo Jet heating equipment. The ready flexibility of this system to suit the varying temperatures fully meets the growing requirements of railroad service. The elegance of detail in car lighting is also keeping pace with the perfection in utility, and the designs as shown in the illustrations are exquisite. Copies of the Safety Heating and Lighting News may be had on application.

"The Modern Car for Transportation" is the title of an illustrated pamphlet recently published by the Pressed Steel Car Company, of Pittsburgh, Pa. The work represents the finest specimens of the printers' and engravers' art, and gives an excellent idea of how various forms of steel cars look inside and out. The art of building steel cars is still new to most people, who can receive much practical information from the study of this very seasonable publication. "Steel Passenger Cars" is a very live subject of conversation these days. Those wishing to shine in this line of conversation, ought to send for the pamphlet we are writing about.

Boiler Washing.

The F. W. Miller Heating Company, 316 McCormick building, Chicago, Ill., has just issued a finely illustrated 16-page bulletin descriptive of their hot water wash-out and refilling system, which should be carefully perused by all in charge of locomotive boiler washing. The reports of saving in point of time and expense, which are absolutely authentic and can be readily confirmed, are such, that the system is being rapidly installed at many division points in the principal railroads. It may be briefly stated that when the engine is placed upon the engine-pit the steam and water in the boiler are blown directly through a blow-off main in the roundhouse to the Miller apparatus, where its heat is given up to other water for washing and refilling purposes, after which the blown off water is strained and re-utilized in connection with the water previously heated for washing and filling. No preliminary cooling of the boiler is required, as the Miller system furnishes hot water at any temperature from 120 to 160 degrees for washing out. The bulletin, which may be had on application, furnishes full details.

Dixon's Graphite.

The Joseph Dixon Crucible Company, of Jersey City, has just put on the market a new chain graphite, especially intended for lubricating the chains of motor trucks and pleasure cars.

This preparation is put up in sticks, cylindrical shape, 2 ins. by 8 ins., encased in a neat cardboard cartoon and weighing about one pound each. It is made of the same material as the Dixon Bicycle Stick Graphite, with which every bicycle owner is familiar. It is by far the most convenient chain lubricant on the market, for a bar may be carried on the car ready for use at any time. To apply, it is simply necessary to rub the bar against the sprocket side of the chain. The "big stick" makes it easy to keep automobile driving chains in first class condition. Unlike oils and greases, it will not collect dust and dirt.

Penn Steel Castings.

An interesting blotter has just been issued by the Penn Steel Castings and Machine Company showing in fine illustrations the results of a series of tests with Penn special cast steel in cold knotting illustrative of the ductility of this metal. We do not know of similar results ever having been made with an ordinary grade of cast steel. A specimen 15 ins. long is turned down to about 7/16 in. diameter and looped cold. It is then put in the testing machine, as shown on the blotter, and pulled down to a tight knot. This test demonstrates the quality of metal far more conclusively than the ordinary bending test. Send for a copy of this illuminated blotter to the company's head office at Chester, Pa.

The Moon Electric.

A new Electric Headlight has put in an appearance in the railway field, and is undoubtedly destined to become an important factor. The Moon Manufacturing Company, of Chicago, after many years of effort and the expenditure of considerable money, has perfected a device for "Lighting the Way," which combines many points of superiority with simplified design.

The device consists of a direct-connected dynamo and steam turbine, especially adapted to meet railroad requirements. The light itself is a combination arc and incandescent lamp, covered by a glass bull's eye, which in effect is a compound lens, and the rays of light cast upon the track ahead enables the engineer to see an obstacle from fifteen hundred to two thousand feet in advance. The lens has the additional advantage of remaining cool and is the acme of durability. The turbine generator has many points of merit, not the least of which is long life and ease of repair. The dynamo also is unique in many features, and is incased neatly with the cover so fitted as to be dust proof when closed. These covers are so arranged that if inadvertently left open, the jar of the engine will close them, and they will automatically lock. All parts are interchangeable, and it is plain that the entire internal mechanism can be replaced in twenty minutes should occasion require.

The economy in the use of steam to operate the turbine is a most important feature, it being claimed that the headlight, pilot lights, cab lights, etc., will operate on thirty pounds of steam pressure, or equally well on two hundred or more. A descriptive catalogue may be had on application to the company's offices at 128 N. Jefferson street, Chicago, Ill.

Hunt-Spiller Iron.

The Hunt-Spiller iron is steadily growing in popularity. In visiting a large railroad repair shop recently, the writer remarked to the general foreman, "I don't see any broken piston valves about." "No," was his reply, "we use Hunt-Spiller iron." That explained.

Barber Truck.

A severe winter such as we have gone through put a very severe test upon the utility and durability of railroad mechanism. The fact that no broken wheel has been experienced under a Barber truck means a great deal. It means that the lateral travel of the bolster of the truck eliminates the shocks that produce breakage.

Duval Packing.

The use of superheated steam has knocked a few old reliable devices out of business. It has been particularly hard on old styles of metallic gland packing. Instead of injuring the reputation of the Duval metallic packing, we are informed that superheated steam has greatly increased the popularity of that packing. Those interested should send to the Power Specialty Company, 111 Broadway, New York, for their catalogue and sample.

National Boiler Washing.

The various water softening and purifying systems help to prolong the life of locomotive flues and side sheets, but the most efficient remedy for the evils caused by hard feed water is proper washing out. The railroads that have tried the National boiler washing system, handled by the National Boiler Washing Co., Railway Exchange, Chicago, talk in the highest terms of the improvement effected over old methods. Give the new plan a trial.

Commonwealth Steel.

The increase of weight of railway rolling stock keeps up a constant demand for stronger parts. It is not so long ago since iron castings were considered strong enough for purposes that now demand only steel and that of the best. Those who have had much experience say that castings made by the Commonwealth Steel Co., St. Louis, are thoroughly reliable. Clarence H. Howard, president of the company, an old master mechanic, knows what is wanted and insists on it being supplied.

Headlights in Canada.

Taylor & Arnold, Ltd., the largest railway supply house in the Dominion of Canada, has become the sole representative in Canada of the American Electric Headlight equipment for locomotives, a product manufactured by the Remy Electric Company, Anderson, Indiana, U. S. A.

The branches maintained by the Taylor & Arnold Company at Winnipeg and Montreal will be used as Service Stations for railroads equipped with the American Headlight, as well as distributing and selling points. Each supply station will carry a full complement of the Remy Headlight product, employ a corps of skilled mechanics, and in every way facilitate the installing and using of the American Headlight.

As a result of exhaustive tests made on one of the largest railroads in Canada, the American Headlight is claimed to be the most economical in the use of steam,

A Question of Speed.

Excited Passenger—"Can I catch the two o'clock express for New York?"

Railway Official (calmly)—"That depends on how fast you can run as it started five minutes ago."

Avoid This Mistake.

Ticket Collector—"We don't stop there, sir."

Montague Swank (who has just given up a ticket)—"Stop where?"

Ticket Collector—"At the pawn broker's."

The Block System.

There was a grinding of wheels, the air came on slowly and the train groaningly stopped. An irate and weary passenger grabbed the sleeve of the porter as he hurried through, and demanded: "What's the matter now? This is the third time we've stopped. What is wrong?" "Nothin', suh, nothin'," replied the suave and courteous Ethiopian. "Dat's jest de block system workin'."

Left Small Space.

A very small man—not only small as to stature, but lacking also in width of beam—sat in a P-A-Y-E car on the 34th street line until he became tightly wedged in from both sides. Then there entered the car a large, handsome woman, upholstered to the minute. She took the strap in front of the small man and was hanging to it in snugly corseted discomfort when the small man arose with a flourish of politeness and touched her on the arm.

"Take my seat, madam," he said with a bow and a smile.

"Oh, thank you very much," she replied and turned toward the seat.

Then, smiling genially again she asked: "Where did you get up from?"

It Was the Wrong End.

A certain Southern railroad was in a wretched condition, and the trains were consequently run at a phenomenally low rate of speed. When the conductor was punching his ticket, Artemus Ward, who was one of the passengers, remarked:

"Does this railroad company allow passengers to give it advice, if they do so in a respectful manner?"

The conductor replied in gruff tones that he guessed so.

"Well," Artemus went on, "it occurred to me that it would be well to detach the cowcatcher from the front of the engine and hitch it to the rear of the train; for, you see, we are not liable to overtake a cow, but what's to prevent a cow from strolling into this car and biting a passenger?"

It's the Language.

"Waiter," said the traveler in an Erie Railroad restaurant, "did you say I had twenty minutes to wait, or that it was twenty minutes to eight?"

"Naything. Oi said ye had twinty minutes to ate, an' that's all ye did have. Yer train's just gone."

The Exact Time.

Breathless Would-be Passenger—"Stationmaster, when does the half-past-five train leave?"

Stationmaster—"Five-thirty."

Passenger—"Well, the new church clock is twenty-seven minutes past, the Post Office is twenty-five past, and your clock is thirty-two minutes past. Now, in the name of goodness, what clock am I to go by?"

Stationmaster—"You can go by any clock you like, but the train has gone."

An Old Goat.

An old and weather-worn trapper was recently seen sauntering along the main street of a Western village. Pausing in front of a little meeting-house for a moment he then went in, and took his seat among the congregation. The preacher was discoursing on the subject of "the sheep and the goats," and had evidently been drawing a contrast between the two. Said he—"We who assemble here from week to week, and do our parts and perform our duty, are the sheep; now, who are the goats?" A pause, and our friend the trapper rose to his feet, saying—"Wa'al, stranger, rather than see the play stopped I'll be the goats!" The preacher collapsed.

Humbled.

A masher walking up and down the platform of a railway station with a companion who had come to see him off observed two handsome girls enter a first-class carriage. "Look here," he said to his companion. "I will get into the same compartment, and I'll tell you what I want you to do. When the train is about to start you come up and touch your hat and say to me, 'My Lord, the guns and the dogs are in the van.'" His companion smiled assent. The masher took his seat with a lordly air in the same carriage with the young ladies whose interest he wished to excite. The moment arrived, and the train began to move, when his companion came up to the carriage window. "Hi, Jock," he shouted, "tell your master to be sure to send those sausages I bought in his store this morning Don't forget, and I'll treat you to a hot dog tomorrow night."

The First Public Railway.

As is well known the Stockton and Darlington Railroad, England, was the first line to be opened to general traffic. The event took place on Monday, September 27, 1825. The jubilee of the occasion was celebrated in 1875, on which occasion Messrs. E. D. Walker and Wilson, Darlington, published an interesting series of illustrations showing some of the works and rolling stock. Portraits of George Stephenson, Messrs. J. and E. Pease, and of Mr. F. Newton, were included, as well as a copy of the first time table. The publishers have just issued a new edition of the elegant publication which forms a very interesting souvenir, and copies may be had direct from the publishers at forty cents per copy.

Origin of Leap Year Proposing.

Why are ladies permitted to "propose" every fourth year? is a question which many ask themselves. It is stated that about the year 1228 the Scottish Parliament ordained that "during the reign of her maist blessit Majesty (Margaret) every maiden lady, of both high and low degree, shall have liberty to speak to the man she likes. If he refuses to take her to be his wife he shall be mulct in the sum of one hundred pounds Scots (£8 6*s.* 8*d.* stg.), or less, as his estate may be, except he can make it appear that he be betrothed to another woman, then he shall be free." It would appear that after Queen Margaret's death another Act of Parliament was passed, and this Act granted females the right, if they choose, to "propose" every fourth year.

Advertising.

Breathes there the man, with soul so dead,
Who never to himself hath said:
"My trade of late is getting bad,
I'll try another Railway ad."
If such there be, go mark him well;
For him no bank account shall swell,
No angels watch the golden stair
To welcome home the millionaire.
The man who never asks for trade
By printed line or ad. displayed,
Cares more for rest than worldly gain,
And patronage but gives him pain.
Tread lightly, friends; let no rude sound
Disturb his solitude profound,
Here let him live in calm repose,
Unsought except by men he owes,
And when he dies, go plant him deep,
That naught may break his dreamless
sleep;
Where no rude clamor may dispel
The quiet that he loved so well.
And when the world may know its loss,
Place on his grave a weath of moss,
And on a stone above, "Here lies
A chump who wouldn't advertise."

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXV. 114 Liberty Street, New York, May, 1912. No. 5

On the Lehigh Valley.

Reference has been made so frequently in the pages of Railway and Locomotive Engineering to the interesting history and fine equipment of the Lehigh Valley Railroad that it would be difficult to present much that is really new in regard to the matter, but as the marked improvements on the great road grow year by year, it cannot be other than of interest to occasionally glance at the familiar features that are growing into grandeur as time rolls on, and recall, however briefly, the humble beginnings and mark the splendid expansion of this magnificent highway that, started as a small coal-carrying road among the mountains of Eastern Pennsylvania, feebly struggling to bring a few coal cars to the nearest canal, until now when it links the Atlantic seaboard to the great lakes with a shining pathway of steel, over which the gorgeously equipped trains pass with winged speed, and with a degree of elegance and comfort to the traveling public that is not surpassed in the experience of thousands of people accustomed to railroad journeys.

In 1835 the Beaver Meadow railroad was constructed by several enterprising Pennsylvanians. As an engineering feat the work surpassed anything hitherto attempted. The curves and grades among the mountains around Mauch Chunk were, in point of sharpness and steepness, something resembling the scenic miniature railways in operation at popular watering places. For this road the firm of Garrett and Eastwick of Philadelphia, obtained an order to build a locomotive. It was named "Samuel D. Ingham." It was really the first of what afterwards, with some modifications, became the "American" type of locomotive, and for more than half a century the most popular type of locomotive in the world. It was furnished with inside frames and outside cylinders. With a four-wheeled swivel truck and one pair of driving wheels on front of the firebox and another pair in rear of the firebox, it had the elements of flexibility and adhesion in a greater degree than any other locomotive up to that time. It was the first engine built with the deck covered to afford protection to the enginemen. The cab was not roofed, but it was the beginning of a very desirable improvement in the direction of the finished cab. The rails were of the strap kind 2½ ins. by ⅝ in. laid on pine stringers. The valve gear was the invention of Mr. Andrew M. Eastwick, and was entirely original. A sliding block was placed between the slide valve and the valve seat, which by opening or closing the ports leading to the cylinder, acted as a reversing gear.

Improvement followed improvement. There appeared the first equalizers, and the first counterbalanced wheels. It need hardly be said that with such enterprise and such inventive ingenuity, together with such vast mineral and agricultural wealth the growth of railroading was rapid. Branches sprang into being all along the rich and fertile valley. In the early 50's they were nearly all consolidated into what is now known as the Lehigh Valley Railroad. Business came to the enterprising promoters beyond their most sanguine anticipations. The locomotive grew with the growth of the road. In the 60's appeared the first consolidated loccomotive, the work of Mr. Alexander

BLACK DIAMOND EXPRESS ON THE LEHIGH VALLEY RAILROAD.

Mitchell, for many years one of the leading engineers of America, and who has left his imprint strongly marked on the modern locomotive. He was particularly fortunate in being employed by the Lehigh Valley Company, which has always shown a ready desire to adopt improvements looking toward safety and efficiency. Probably the latest improvement of importance in the locomotive was the introduction of the Wootten boiler, which on account of the extended firebox, marked an advance in efficiency and economy in the use of fuel.

MAIN LINE, LEHIGH VALLEY RAILROAD AND LEHIGH RIVER NEAR RICHARDS' FARM, PA.

It should be borne in mind that the perfecting of the modern locomotive was not the only thought active in the minds of the leading men on the railroad. The repair shops at Wilkesbarre, and latterly and more particularly at Sayre, embrace all that is known in the best mechanical appliances used in construction and repair work. At the latter place the main building is perhaps the largest of its kind in the world, measuring as it does 750 ft. in length by 360 ft. in width, with accommodations for the building or repairing of 52 locomotives. The distribution of tools in this hive of industry is an example of the advanced methods under the scientific management in vogue. There are 60 electrically equipped stations throughout the shop, to the nearest one of which the workman desiring a tool comes and writes on a pad, and touches a button, and goes about his business. A messenger from the tool room arrives, and without loss of time the workman is supplied with the desired tools or material.

There are now about 900 locomotives in operation and about 1,500 miles of track. The distance between Jersey City and Buffalo, 448 miles, is traversed in about ten hours, and while this speed may not seem remarkable, it should be remembered that the second section of the road from Easton to Sayre, a distance of 194 miles, is almost entirely through one of the most mountainous regions in America, with a continuity of grades and curves that consume nearly the half of the time of the entire journey. This district has been aptly called the Switzerland of America, and combines a panorama of the most beautiful scenery imaginable. In the splendor of summer or in the gorgeous glory of the early autumn it is the wonder and delight of the traveler from every land. It is a combination at once of the brilliance of Brazilian forests, with the richly cultivated, pastoral valleys of England, and the clustering towns now expanding into cities give it a human interest that is at once delightful to the eye, and gratifying to the mind.

It will also be remembered that the road passes through the greater part of the beautiful and romantic valley of Wyoming, the scene of Campbell's exquisite poem, "Gertrude of Wyoming." It was also from the wheat fields of this fertile valley that American armies under Washington were supplied during the weary years of the revolution. The coal deposits underground have subsequently proved to be of much more value than the agricultural products, while the chain of towns almost cover the twenty miles of valley from end to end.

We cannot close without briefly referring to the substantial improvements in the railway itself. It seems now as if set from end to end on solid rock. Culverts of concrete, bridges and viaducts of steel, ballasting of adamant—all seem as if built to last forever, while the officials from the highest to the humblest seem to have caught the spirit of the enterprising promoters and vie with each other in rendering the public the best service.

ROCKDALE CUT ON THE LEHIGH VALLEY RAILROAD.

How a Superintendent Flagged

By Old Jack.

Some years ago, not very many, however, there happened on one of our Western roads one of those little incidents that are interesting, amusing and instructive, but where the laughable part is not really enjoyed until some time after, things being serious just at the time.

The reason that we don't say just when and where this all happened is because the engineer is alive and well yet, and the superintendent is vice-president and general manager of a great system, and will appreciate this joke on himself all the better for not being given entirely away; but for the tale:

It was snowing everywhere, from the Mississippi to the Rocky Mountains, and what trains were not stalled in drifts stack high, or abandoned to avoid stalling, were not on time by many hours. The mails must be kept moving, however, and the mail car and one coach were about the size of most trains, and passengers hardy enough to venture were few.

One old engineer succeeded in getting over his division on time, and found on the end of the run that there was not another engine to go over the next division as "pilot engine," to run ahead of the train to clear the track of snow, cattle and other obstructions, and he was asked by the superintendent to go himself. The old man shook his head, remarked that it was "pretty rocky," but finally said he would go if they would wait till he got ready. As there was nothing else to do, they waited.

Our hero was cool, he looked out over the prairies into the storm, and told the hostler to take the engine to the house, have the ice knocked off the running gear, a full tank of coal and water put on, and the oil cans all refilled and fire cleaned, while he and the fireman got outside of a hot supper and had their lunch pails filled for a siege. In half an hour all was ready, the light engine stood in front of the train, and both in front of the office. The superintendent was nervous and concluded to go himself on the light engine, so that there might be no mistake. After oiling around carefully, looking to the headlight and pounding the sand pipes open, our engineer got up on the engine. The fireman had the pointer at 140, and all in readiness for a hard run. The superintendent was perched up on the fireman's seat, hid in an ulster and a pair of No. 13 overshoes, and inwardly chafing because the engineer was slow. As the old man wiped off the oil can, he said to the fireman: "Light me a lantern and put a couple of torpedoes on the guards." The official had to get up for Mike to find the booms in his seat-box, and asked the engineer: "What in thunder he wanted another lamp for, the fireman had one lit." But the old man put the light in front of his box, got his legs in front of the reverse lever, and remarked as he pulled out: "That's for me." The storm was raging in all its fury, and at every cut or bank the engine dove out of sight for a moment, and then emerged, covered with a shroud of purity. Through every crack and opening in the cab there was a thin knife of sharp wind and snow pointed at the three men, who were straining every nerve to see before them; when out onto a high fill this was possible, but any other time it was not. Half a mile back they could catch occasional glimpses of the headlight of the oncoming train.

After passing a certain bridge, the engineer turned to the fireman and said: "Mike, fill her up to the crown sheet." The fireman obeyed, but wondered what had struck "the old man." When Mike had a couple of tons of coal in the firebox he dropped the curtain and the old man said: "Now, don't pay any attention to the fire, but look out for stock; these cuts will be full half snow, half bulls." "Got one here," said the fireman, as they emerged from a cut. "Look out now," said the engineer, but they made a mile or two at a good speed without seeing any stock; but the old man kept up his lookout and cautions. The next deep cut had a herd of stock in it, huddled up to keep out of the fierce wind; into this cut the old Roger plunged, covered herself with snow—and cows reeled a little and stopped.

Experience had taught the fireman that the reeling meant off the track, and he had lit head first in the snow drift at the first lurch. The engineer coolly threw the reverse lever ahead again and said, "Mike, flag the train." But Mike was gone. "I'll flag," said the half-frozen official, as he got the fireman's lantern; "but why don't you go? You're out of the cut, and they may run into you." "The trucks are on the ground; you fly!" was the command; he did fly.

Our superintendent was one of those men who can get a poor engineer or conductor up into his office and scare him into the blind staggers by deep questions on operating railways, but when he came to the trails of the operation he was as bad as a green boy off the farm. He had the lantern and was off the engine in a minute, around the tank in another, and before the third minute was up, he stumbled over a dead steer rolling down the bank, and his lantern went out at the first stumble.

Our engineer quietly, but quickly, turned up his lamp, and started to go back himself, but met the bold Mike at the gangway, and that hearty seized the signal lamp and went back on a double-quick. In a few minutes the express stopped a few feet behind the disabled engine. The hatless snow-packed officer now showed up, and never ventured a remark while the train men coupled the second engine into the first and pulled her onto the track, gave her a shove through the next snow cut, and came back for the train. He took a seat by a red hot stove and tried to dry out.

A few days later he met the engineer and said: "I learned a little real, live railroading the other night. If you were as green at it as I am, there would have been blood spilled over there." "And," said the engineer, "if all the engineers in the country were as poor practical railroad men as yourself, what then?" The young, but honest, official shoved his hands deep into his trousers pockets while he hunted his brain garret over for a fit comparison, and finally remarked: "We'd better have the cholera." "Remember one thing, old man," said the knight of the throttle, "and that is, to always protect yourself, running or standing still; look out that you keep out of the other fellows, and keep the other fellows out of you. I am going out with a very leaky old scrap heap tonight, come along, and I will give you a practical answer to your oft-wired question, "What is the cause of this delay?"

The Eyes of Fishes.

Nature is a pretty thorough workman. In her production she generally provides just those functions which are needed, and they are always the best that can be devised to do the work. The eyes of fishes may be taken as a case in point.

In the deep sea, below 200 fathoms, where very little light from the sun reaches the bottom, fishes and shrimps are found with eyes of enormous size. They require a large lens to collect what little light reaches them, and as we go deeper, and even side by side with the large-eyed kinds, we find fishes and shrimps and crab-like creatures with no eyes at all. It seems as though they had given up the attempt to see as a bad job, while some of their fellow deep-sea inhabitants are still struggling by aid of enormous lenses to get a glimpse of the almost sightless world around them. Many of these deep-sea fishes and crustaceans have no trace of eyes at all; others have what were once eyes converted into flat, plate-like structures, the use of which is unknown.

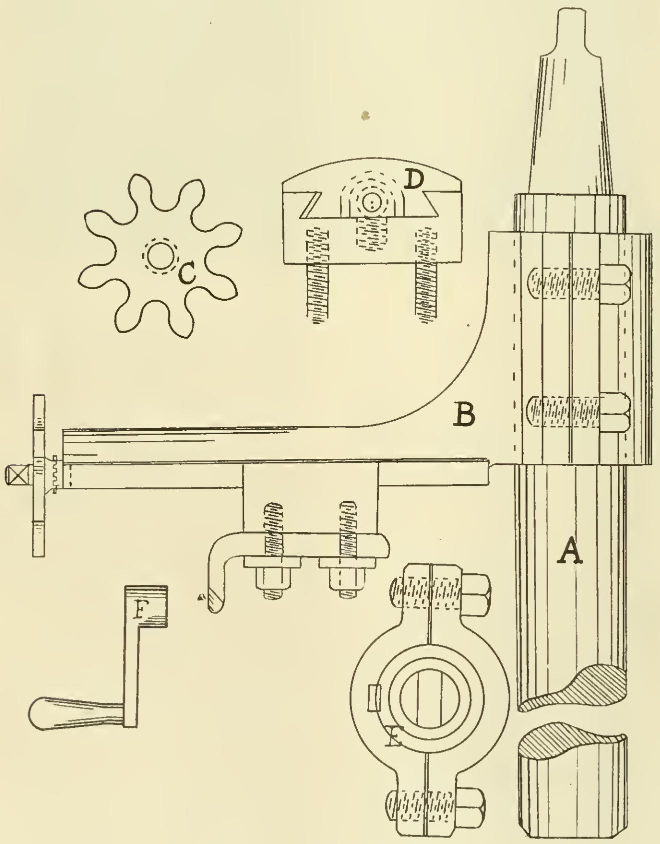
General Correspondence

Facing Driving Boxes.

Editor:

Enclosed are sketches showing details of a device that can be attached to an ordinary drilling machine and used either to bore out or face driving boxes. By the use of this apparatus the driving boxes need not be sent to the main shops but the work may be done in any roundhouse where there is a drill press with a table large enough to fasten the box upon, and with a hole in the center of the table to receive the end of the shaft.

The accompanying illustrations show the outfit for facing the box. A, is the boring bar. B, is the supporting arm for the movable tool block, with tool attached. C, is the automatic feed star. D, is the tool block slidably engaged on the supporting arm. E, the outfit, looking from the top, and F, the handle for attaching to the end of spiral screw running through tool block, and by the use of which the tool may be rapidly moved to the point desired. An extra attachment for tool when boring out boxes will readily suggest itself to the intelligent mechanic.



DEVICE FOR FACING DRIVING BOXES.

Montreal, Canada.

J. G. Koppell.

Superheated Steam.

Editor:

I have no desire to enter into further controversy with Mr. A. J. Schmidt in regard to superheating or superheated steam. Since he questions some of my remarks, however, in his recent letter, I would simply call his attention to the fact that the superheater tubes are open to the boiler at one end, regardless of how tortuous the passage may be. I will admit, however, that I obtained my information from a different source from whence Mr. Schmidt evidently obtained his, mine being obtained from the locomotive itself, not only in setting it up, but afterward testing it.

I would also like to call Mr. Schmidt's attention to the fact that the laws governing saturated steam have been known since the time of Hero; and the laws covering gases (and superheated steam is a gas) have stood unrefuted since the time of their announcement by Boyle and Marriot, and it will take more than a mere assertion on the part of Mr. Schmidt to cause the mechanical world to now question these laws.

I once heard a story about a farmer visiting a circus, who upon first beholding an elephant, examined it carefully, then, turning to his neighbor, remarked: "There ain't no such animal."

F. P. Roesch,
Mast. Mech. E. P. & S.

Douglas, Ariz.

Hot Furnace Door.

Editor:

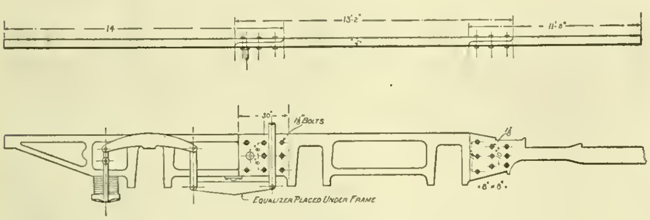
Probably you or some of your experienced readers may be able to enlighten us in regard to a trouble we are experiencing here in regard to a class of 2-8-0 type of locomotives. The cylinders are 22 ins. by 30 ins., and the stack is 16 ins. in diameter, with master mechanic's front end, including draft pipes 13 ins. by 24 ins., the flare being adjusted to 3¾ ins. above the exhaust nozzle tip and 4¾ ins. from base of smoke stack. The engine steams well and does not burn too much coal. The exhaust nozzle is 5¼ ins. wide. Everything is apparently in good working order, but the heat of the fire-box door is excessive. Firemen have had their clothes burned and their faces blistered. Experiments have been made with the draft pipe and

deflector sheet, but when the heat of the door diminishes, the engine steams very poorly. The fire burns level. The deflector or draft sheet is in its best position for steaming qualities at 18 ins. above the bottom of the box. We would esteem it a favor to have expert opinions on the subject.

J. W. M.

Van Buren, Ark.

We trust some of our readers will favor us with an account of their experiences with superheated fire-box doors. Such cases are not uncommon and are generally owing to some defect in the details of the smoke box.—Ed.



THREE-PIECE LOCOMOTIVE ENGINE FRAME.

Three-Piece Frame.

Editor:

Attached print shows a three-piece modern locomotive engine frame which I consider woud be better than the continuous frame which is now in general use. You will note that the frame has slab splices with bolts through the frame. The bolts can always be removed without danger to them or the holes. If the holes should have to be reamed for new bolts occasionally it would not weaken the frame, as the old style of top and bottom holes do. If the back, middle or front part of this frame becomes damaged or broken it could be easily taken apart, and cheaply handled in the ordinary shop, without dismantling the entire engine. Possibly this construction will interest readers of Railway and Locomotive Engineering.

Chas. Markel.
Shop Foreman.

C. & N. W. Ry., Clinton, Iowa.

Record-Breaking Mileage.

Editor:

We are pluming ourselves here with the belief that with good management on the Santa Fe we are making better mileage of locomotives between the periods when general repairs become necessary than any other road in America or anywhere else. Locomotive No. 1443 may be taken as an illustration. This engine was delivered to us by the Baldwin Locomotive Works in June, 1907. In December, 1911, it was sent to the repair shops at Topeka for general repairs. During this period of four years and five months the running repairs had been of the slightest kind. The locomotive had run 269,899 miles on high-speed passenger service. The original flues were still all in service. The locomotive is of the Atlantic or 4-4-2 type, with Stephenson link motion, and is typical of our class of balanced compounds. The service rendered by the locomotive was on no special level run, but on a variety of grades and curves on the Middle, Southern Kansas and Oklahoma divisions. The only special qualities that contributed to the remarkable record was the fine skill of the engineers and firemen, and credit must also be given to the mechanical department of the divisions referred to. Their methods of making running repairs are thorough and exact.

If among your thousands of readers there are any who know of a better record than this, we will be pleased to hear of it.

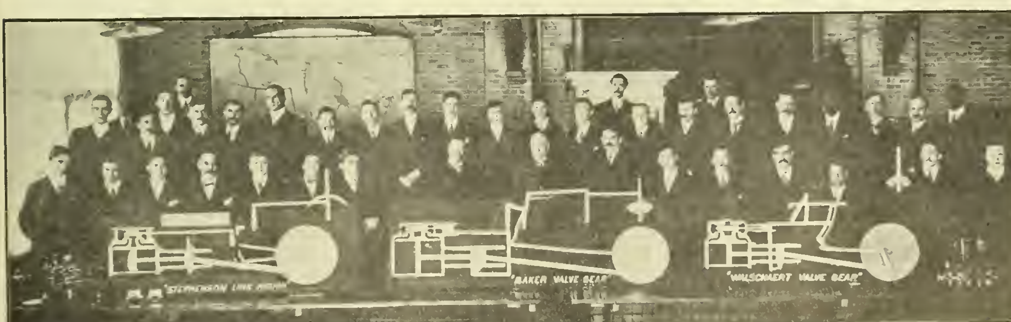
G. W. Wilcox,
Santa Fe R. R.

Newton, Kan.

Educational Facilities on the Canadian Pacific Railway.

Editor:

As you are well aware the educational facilities for assisting young men in obtaining proficient knowledge of railway mechanical trades are much more readily secured than formerly. Railway and Locomotive Engineering has been a pioneer in the good work and is still a leader in its chosen field. First-class all round mechanics are always in demand, and it is pleasant to observe that the leading railways are trying various methods to increase the supply by rendering valuable assistance to studious young men in order to equip them thoroughly with a full knowledge of the mechanical trades. In this work the Canadian Pacific railway, the longest railway in the world, has been among the foremost in advancing the opportunities for young men to prepare themselves for their life's work and also to instruct them in the higher educational and technical knowledge essential to those who may be called upon to fill positions of higher responsibility on the various departments.



VALVE GEAR CLASS, CANADIAN PACIFIC SHOPS, MONTREAL, CANADA.

When this work began, several years ago, it met with a ready response, and it was soon found necessary to enlarge the scope of the teaching, as it seemed that the lamp of hope was speedily kindled in the minds of the young mechanics, and a little knowledge did not satisfy them, but all seemed to aim at a complete mastery of the technical as well as the

mechanical part of the work. It was particularly encouraging to the young men to find that Mr. Lacey F. Johnson, our gentlemanly and accomplished assistant superintendent of motive power, and the other officials associated with him, were desirous of placing everything necessary in the hands of the students, so that, in point of equipment, the schools that were opened at all of the large railway centers lacked for nothing that was necessary. Several of the graduates of these schools are already holding important positions on the road, and some who have gone into other industrial concerns are already reaping the reward of their training.

It should be noted that the entire cost of the instruction and appliances at these schools is paid for by the railway. The instructors in the various departments are all well qualified by education and experience, and examinations are held at the different centers and thus a spirit of friendly rivalry is being maintained that adds keenness to the mental development of the earnest scholars. An admirable feature of the work is the fact that attendance at the classes is compulsory, part of the time of attendance being in the working hours and part in the evenings. The record of each student is open to inspection by all, and the necessity of keeping up with the class is thereby brought home to the scholars and a generally high standard of excellence is the result.

Another excellent feature of the training of the young men on the Canadian Pacific is the fine spirit shown by a number of the brightest young men taking what is known as the five-years' course. This embraces a certain period of time in each of all of the mechanical departments in addition to the four-years' training in the special department to which the apprenticeship has been continuously served. In this way there will soon be a large number of young men with more than ordinary training, and particularly qualified for the higher positions which call for an all round training that cannot fail to redound to the credit of the company in securing a maintenance of that high degree of fitness for the important positions which, in the very nature of things, are growing in number and importance.

It may be added that in the matter of models, there is a full supply of lubricators, inspirators, stop-valves and other appliances, all fitted to facilitate demonstrations. In the matter of valve gear models, with the approval of Mr. Johnson, I designed the models shown in the accompanying photograph. You will note that in addition to Mr. Johnson, Mr. R. K. Moodie, assistant superintendent of locomotive shops, and Mr. Upton, chief inspector, appear in the group, which does not represent more than half of the attendance at the valve gear class, owing to the pressure of work in the shops.

The Stephenson link motion, Walschaerts valve gear and, last but not least, the Baker valve gear are demonstrated with the use of the adjustable working models shown in the picture, introducing several original features. Every portion of the work is subject to the criticism of anybody interested, and many interesting points are brought out in the discussions following some of the questions.

OFFICIALS OF THE ANGUS SHOPS, C. P. RY., MONTREAL, CANADA.

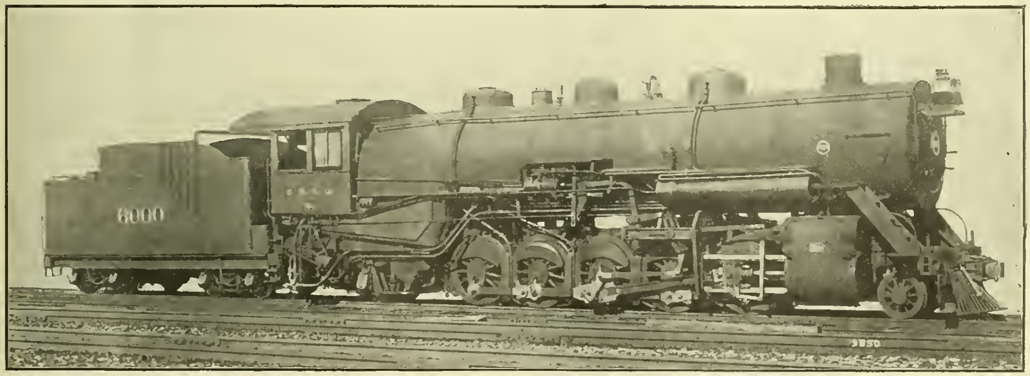
We believe that such work as this will prove of special interest to men connected with the building or maintenance of locomotives. It serves as an example of what might be done by other companies towards the education of their employees, to more efficient labor and ultimately leading to more economical use of fuel.

John H. Britton,
Apprentice Instructor,
C. P. Ry. Shops.

Montreal, Canada.

2-10-2 Type of Locomotive for the Chicago, Burlington & Quincy

Any one imagining that the limit of weight and hauling capacity in locomotives has been reached, when all the driving wheels are coupled in one group, has but to note the products of the leading locomotive builders during the present year. The Baldwin Locomotive Works has recently completed, for the Chicago, Burlington & Quincy R. R., five locomotives of the Santa Fe, or 2-10-2 type, which are unquestionably the largest engines ever built with all the driving wheels coupled in one group. With a total weight of 378,700 lbs. and a tractive force of 71,500 lbs., these locomotives exceed in weight and hauling capacity many Mallet engines of the 2-6-6-2 type now operating in this country. This has been accomplished in a locomotive carrying approximately 60,000 lbs. on each pair of driving wheels, and having a ratio of adhesion of 4.22, which is a desirable proportion for an engine of this type.



2-10-2 TYPE LOCOMOTIVE FOR THE CHICAGO, BURLINGTON & QUINCY R. R.
F. A. Torrey, Gen. Supt. of Motive Power. Baldwin Locomotive Works, Builders.

The 2-10-2 wheel arrangement is not new, as it has been applied by The Baldwin Locomotive Works to 160 locomotives built for the Atchison, Topeka & Santa Fe Railway, and to a similar engine for the Pittsburgh, Shawmut & Northern Railway. These locomotives were all constructed during the years 1903 to 1907. In them the rear truck was used principally to improve the curving qualities, and the firebox had a shallow throat and was placed over the rear pair of driving wheels. In the new Burlington locomotives, the firebox is placed back of the driving wheels and above the rear truck wheels, and advantage is taken of the opportunity to deepen the throat. The increase in weight over the Santa Fe locomotives is 35 per cent., and the increase in total equivalent heating surface is 38 per cent. The Burlington locomotives are fitted with superheaters, and in making the above comparison each square foot of superheating surface is considered equivalent to 1½ sq. ft. of water evaporating surface.

The locomotive now under notice will be used in the coal business on the Beardstown (Ill.) division, and efforts will be made to so distribute cars that they will handle rolling stock of only the strongest and best types. These engines, although they have a rigid wheelbase of 20 ft. 9 ins., are designed to traverse 21 degs. curves. To facilitate this, the tires on the main driving wheels are without flanges; the intermediate flanges have a play of ⅝ in., and the front and back flanges of ⅞ in. The truck wheel flanges have a play of ¾ in.

The boiler has a straight top, and measures 88½ ins. in diameter at the front end. The barrel is composed of three rings, and the third ring is tapered, the slope being placed on the bottom. This construction was adopted because the firebox has a combustion chamber, and room had to be provided under the same to permit free circulation. The depth from the underside of the combustion chamber to the shell is approximately 7 ins., and the front water leg has a width of 6 ins. The crown of the combustion chamber is stayed by two T-bars hung on expansion links; otherwise radial bolts are used. A total of 501 flexible bolts are placed in the sides, throat and back head.

These locomotives are fitted with Emerson superheaters, and the elements are placed in 30 tubes, each 6 ins. in diameter. The superheater pipes are 1¾ in. diameter outside. The saturated and superheated steam headers are separate castings, and are bolted together in such a way as to allow a slight relative movement, thus providing for unequal expansion and contraction. In other respects the superheater is closely similar to those which have been previously used on this road.

Barnum stokers are applied to these locomotives, and the installation is of special interest owing to the large grate area (88 sq. ft.) which must be covered. This stoker is of the underfeed type, and the furnace is charged with coal by four screw conveyors which work in suitable longitudinal troughs. The conveyors are 28 ins. apart measured transversely. The clearance between the conveyor and the bottom of the trough, can be adjusted to secure the most satisfactory results. Each trough contains a series of inclined plates, which are placed above the conveyor, and as the coal strikes these plates it is fed upward into the furnace. The plates are adjustable for height and inclination. The conveyors are worked by a transverse worm shaft, which is placed at the back end and is rotated by two small steam engines. On the tender is placed a Bacon coal crusher, which is driven by a 6 ins. x 6 ins. engine. The crusher delivers coal to a belt, which conveys it forward to a transverse trough placed above the foot plate. From this trough the coal is discharged into the longitudinal feed troughs. The fuel bin in the tender contains a Ryan-Johnson coal pusher.

The fire door is not encumbered by the stoker equipment, so that if necessary the locomotive can be fired by hand.

The grate is composed of three sections, which are placed between the adjacent stoker troughs. The bars of each section are connected to rock in two groups. Each bar is set in a rectangular frame, which can be tilted through a wide angle when the fire is dumped. Below each section of grate is placed an ash pan, having two hoppers. There are thus six hoppers altogether, and they are provided with cast iron drop bottoms.

There is no arch in the firebox, but a brick wall, 24 ins. high and 9 ins. wide, is built in the combustion chamber. The front of the wall is 16½ ins. back of the tube sheet, and the vertical distance from the top of the wall to the under side of the crown sheet is about 38 ins.

The cylinders are of the usual design, each being cast in one piece with half the saddle. The cylinder barrel walls are 2 ins. thick. The live steam passages in the saddle are connected by an equalizing pipe. The steam distribution is controlled by double ported piston valves, arranged for inside admission. These valves are 15 ins. in diameter, and are set with a lead of ¼ in. Circulating valves of the Sheedy type are applied, and relief valves are tapped into the live steam passages.

Attention may be called to several features in connection with the driving gear. The pistons have dished bodies of cast steel, with cast iron bearing rings. These rings are 6 ins. wide, except at the bottom where they are widened to 8 ins. The main rods have an I-section, while the side rods are rectangular. The side and main rod stubs on the main pin are of the strap type, with three bolts and a wedge adjustment. The side rod stubs on the second and fourth pairs of wheels deserve special mention. The knuckle pins on these stubs work in spherical bushings or case hardened steel, and these bushings are held in place by brasses having a wedge adjustment. With this arrangement, the front and back pairs of driving wheels are allowed a side play in the boxes of ⅜ in., and the rods can accommodate themselves to the position of the wheels when the engine is traversing curves.

The main driving axle and main crank pins are of vanadium steel. The difficulty of providing the necessary amount of counterbalance in the main wheels is largely overcome, in this locomotive, by placing cast steel counterweights on the axle between the frames. These counterweights are pressed on, and keyed in place. The journal diameter is 12 ins., the wheel fit 12½ ins., and at the counterweight the diameter is 12⅝ ins.

The valve motion is of the Walschaerts type, and is controlled by the Ragonnst power gear. The valve rod cross-head works in guides which are cast in one piece with the back steam chest head. The crosshead is an iron casting, also made in one piece. The combining lever is forged solid at its upper end, and is embraced by a jaw on the radius rod.

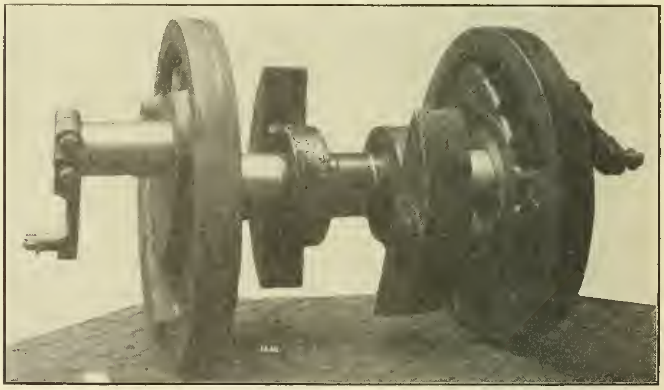
The frames are steel castings, 6 ins. wide, with separate rear sections 4½ ins. in width. The front rails are double, and the construction here deserves notice. The lower rail of the main frame is extended forward under the cylinder saddle, thus giving a long bearing for the separate rail which is bolted to it. This separate rail is of cast steel, and is formed with a lip which bears against the inside face of the main frame and also extends almost the entire length of the first driving pedestal. The two frame sections can thus be secured by 9 horizontal and 9 vertical belts. The frames are stopped immediately ahead of the cylinders, where they are bolted and keyed to a cast steel deck plate. This deck plate is bolted to the cylinder castings, and to it, in turn, the front bumper is secured.

The pedestal binders are of cast steel, and they are lugged and bolted to the lower ends of the pedestals. The bolts have castellated nuts. The frame fillets have large radii especially at the upper ends of the pedestal jaws. The shoes and wedges are of bronze. The transverse frame braces include a steel tie placed just back of the cylinder saddle. This tie is bolted to the cylinder castings. Between the first and second pairs of driving wheels, the frames are braced by the guide yoke, and between the second and third pairs by the valve motion bearer. Broad steel castings also brace the upper frame rails between the third and fourth, and fourth and fifth pairs of wheels respectively. Vertical waist sheets are bolted to these castings, as well as to the guide yoke and valve motion bearer, so that there are four boiler supports under the barrel. The mud ring is supported by sliding shoes in front, and at the rear by two vertical expansion links whose centers are 56 ins. apart transversely. These links are seated on the foot plate. Owing to the arrangement of the stoker there is not room, in this locomotive, to apply a vertical expansion plate for the support of the firebox.

The equalization system is divided between the third and fourth pairs of driving wheels. The spring links at this point are pinned directly to the frames. All the driving springs are mounted over their respective boxes, and are connected by cast steel equalizers. The long beam under the cylinder saddle is also of cast steel, while the rear truck equalizers are of forged iron. This truck is of the Hodges type.

Westinghouse-American brake equipment is applied to these locomotives, and four brake cylinders are used. Two of these are bolted to the guide yoke and operate the brakes on the first three pairs of driving wheels, while the two remaining cylinders are bolted to the back waist sheet crosstie, and apply the brakes to the fourth and fifth pairs of wheels. Two 11-in. pumps are provided.

The tender is designed in accordance with the railroad company's practice, and is specially arranged to accommodate the stoker equipment. The tender frame is composed of 12-in. steel channels, while the front bumper is of oak and the back bnmper of steel, built up. The wheels were manufactured by the Standard Steel Works Company. They have cast-iron plate centers with tires secured by bolted fastenings.



MAIN DRIVING WHEELS SHOWING CAST STEEL COUNTERWEIGHTS.

These locomotives are practically a development of the Mikado type engines which were built for this road over a year ago by The Baldwin Locomotive Works, and which have been giving excellent results in service. The new locomotives are of special interest, not only because of their size and the details of their construction, but also because they belong to a type which has not been built for five years. With the constant demand for locomotives of increased hauling capacity, it is not improbable that this type will be used to an increasing extent in the future.

The following are the principal dimensions of this type of locomotive:

Gauge, 4 ft. 8½ ins.

Cylinders, 30 ins. x 32 ins.

Valves, balanced piston.

Boiler.—Type, straight; material, steel; diameter, 88½ ins.; thickness of sheets,

⅞ in.; working pressure, 175 lbs.; fuel, soft coal; staying, radial.

Fire Box.—Material, steel; length, 132 ins.; width, 96 ins.; depth, front, 89¾ ins.; back, 69 ins.; thickness of sheets, sides, ⅜ in.; back, ⅜ in.; crown, ⅜ in.; tube, ⅝ in.

Water space.—Front, 4 ins.; sides, 6 ins. to 4 ins.; back, 4 ins.

Tubes.—Diameter, 6 ins. and 2¼ ins.; material, steel; thickness, 6 ins., No. 8 W. G.; thickness, 2¼ ins., No. 11 W. G.; number, 6 ins, 30; 2¼ ins., 285; length, 22 ft. 7½ ins.

Heating Surface.—Firebox, 255 sq. ft.; combustion chamber, 65 sq. ft.; tubes, 4,841 sq. ft.; total, 5,161 sq. ft.; grate area, 88 sq. ft.

Driving Wheels.—Diameter, outside, 60 ins.; diameter, center, 52 ins.; journals, main, 12 ins. x 12 ins.; journals, others, 11 ins. x 12 ins.

Engine Truck Wheels.—Diameter, front, 33 ins.; journals, 6 ins. x 10 ins.; diameter, back, 42½ ins.; journals, 8 ins. x 14 ins.

Wheel Base.—Driving, 20 ft. 9 ins.; rigid, 20 ft. 9 ins.; total engine, 39 ft. 8 ins.; total engine and tender, 74 ft. 4¼ ins.

Weight.—On driving wheels, 301,800 lbs.; on truck front, 26,600 lbs.; on truck, back, 50,300 lbs.; total engine, 378,700 lbs.; total engine and tender, about 562,000 lbs.

Tender.—Wheels, number, 8; wheels, diameter, 33 ins.; journals, 6 ins. x 11 ins.; tank capacity, 10,000 gals.; fuel capacity, 15 tons; service, freight.

Engine equipped with Emerson superheater. Superheating surface, 970 sq. ft. (steam side).

The Strength of Bone.

The statement that human bone is stronger than solid oak may be questioned by the average man, but it is a fact nevertheless. A very small bone, only one square millimeter (.0155 sq. in.) in diameter, will hold 33 lbs. in suspension without breaking, while a piece of the best oak of the same thickness will hold up only 22 lbs. The bone is, therefore, half again as strong as the solid oak, thus showing that nature is economical in the weight given to bones, making them hollow, and at the same time making them stronger than if they were solid and much heavier. This principle has been recognized in mechanics, engineers using hollow steel tubes instead of solid to meet great strain.

New Type of Locomotive.

French locomotive men have succeeded in evolving a new form of engine which they call the Baltic type 4-6-4. It is intended for double-ended suburban service.

Control of Fuel Consumption.

Professor Henry E. Armstrong read a paper on "The Scientific Control of Fuel Consumption." The author said that in view of the fact that the supply of coal in Great Britain would not last many centuries, the subject was one which called for careful consideration. His object was to plead for the introduction of a new attitude towards the problems of combustion and fuel economy. The effective use of gaseous fuel for the purpose of raising steam and for the production of power in other ways depended on the advance of knowledge in that field. Fuel was not to be judged only by its heating power as determined in the laboratory, other points in this connection being of importance in relation to the production and use of producer gas. Hydrogen and carbonic oxide gases had practically the same heat of combustion, but carbonic oxide was the more effective fuel.

At present we could only look forward to the direct conversion of the energy latent in fuel into electrical energy. No one had yet succeeded in making a satisfactory voltaic battery with carbon, and before coal was burnt electrically it would be necessary to make it a conductor of electricity.

The engineer must remain an engineer, but the chemist must be at his side. At present he was too rarely employed in works in England, and that was one of the great lessons to be learned by English manufacturers of the present day. The opportunities for research in the iron industry were numerous, and it was time that the services of chemists of a high order of ability who could devote their attention to its special problems were called in to aid the engineer. He appealed to the Iron and Steel Institute as the leading body of fuel users in this country to give the matter their careful attention. He suggested that the Government be asked to impose a tax of 1s. on every ton of coal raised to meet the cost of research, and of several shillings on every ton exported for foreign use.

How Icebergs Are Born.

The birth of a huge iceberg, a phenomenon that has been seen only once or twice by a European, and to a certain extent has remained a matter of theory, was observed by the Danish explorers on the east coast of Greenland some time since. The bergs are formed by breaking off from the end of glaciers extending from the perpetual ice of the unexplored interior to the coast and into the sea. The water buoys up the sea end of the glacier until it breaks by its own weight with a terrific crash. The commotion of the water, as the iceberg turns over and over, in the effort to attain its balance, is felt to a great distance along the coast. The natives regard it as the work of evil spirits, and believe that to look upon the glacier in its throes is death.

The Gyrostatic Compass.

A gyrostat resists any force which tends to alter the direction of its axis of rotation, and it was upon this principle that Dr. Anschutz, of Kiel, invented the gyrostatic compass. It would seem that in moving round a globe, the instrument, if free, would not alter from the direction of the axis of rotation, and in the case of the earth the force of gravity makes it impossible for the gyrostat to take up any direction except one, namely, the direction of the axis of rotation of the earth. The gyrostatic compass takes up this position for itself, and maintains a true north and south line. It is entirely non-magnetic. A master compass on this principle can be mounted in the very heart of a warship, the readings being transmitted by electric means to small clock-like dials. These, in addition to the usual compass card, have a smaller card, which makes any deviation from the true course of the ship 36 times as apparent as with the usual compass, thus enabling a much straighter course to be steered. The particular instrument invented by Dr. Anschultz has its axis horizontal, and weighs only 7 lbs. The speed of rotation is 20,000 revolutions per minute.

Fastest Long Distance Trains.

Railway.	From.	To.	Miles.	Speed an Hour.
Northern (France)	Paris	Calais	185.1	59.72
Prussian	Berlin	Hamburg	177.69	52.51
L. & N. W.	London	Edinburgh	393.5	50.77
N. Y. C. & L. S. & M. S.	New York	Chicago	962.49	50.66
Caledonian	London	Edinburgh	401.5	50.18
P. L. & M. (France)	Paris	Mentone	687.5	49.10
Pennsylvania	New York	Chicago	897	47.21
Orleans (France)	Paris	Bayonne	488	49.3
N. Y. C. & H. R.	New York	Buffalo	440	49.3
O. & S. (France)	Paris	Madrid	903	38.49
Various	Ostend	Vienna	822	37.85

Lima Loco. Co.

The Lima Locomotive and Machine Company has just completed an order for ten locomotives of the Switcher type for the Grand Trunk Railway. These are what is known as the 0-6-0 type. The company has manufactured a large number of this type of locomotive and the reports of their performance are all of the best. The fireboxes are large and equipped with a brick arch, and the steaming qualities of their locomotive are said to be exceptionally high. Those just finished for the Grand Trunk are heavier in some of the wearing parts than the older locomotives and their performance will be watched with interest. In point of first-class material and perfect workmanship, the locomotives finely sustain the high reputation of the builders.

The following are the principal dimensions of these locomotives:

Cylinders.—20 ins. x 26 ins.

Driving Wheels.—56 ins.; tires, 3½ ins. x 5½ ins.; journals, 9½ ins. x 12 ins.

Wheel Base.—Engine, 12 ft. 8 ins.; engine and tender, 42 ft. 5½ ins.

Weight.—Engine in working order, 145,250 lbs.; engine and tender in working order, 247,000 lbs.

Boiler.—Straight, radial stayed.

Diameter.—Smallest ring, 66 ins. O. S. D.

Tubes.—264, 2 ins.; over sheets, 12 ft. 9½ ins.; thick, .125 ins.

Firebox.—98½ ins. x 40 ins.; with brick arch and rocking grates.

Heating Surface.—Firebox, 148 sq. ft.; tubes, 1,772 sq. ft.; total, 1,920 sq. ft.

Grate.—Area, 27.3 sq. ft.

Tender.—Capacity, 4,500 U. S. gals.

Coal.—Capacity, 8 tons.

Tender Frame.—10 ins. steel channels.

Wheels.— 33 ins.

Journals.—5 ins. x 9 ins.

Brakes.—Westinghouse American Air No. 6 E. T. Equipment, 3 ins. x 3 ins. Star Safety Valves, Hancock Type A Inspirators No. 9, Detroit Triple Lubricator No. 22, Technical Equipment Company Steam and Air Gauges, Westinghouse 11-in. Air Pump, Air Signal Schedule L, Melrose Couplers.

SWITCHER TYPE OF LOCOMOTIVE FOR THE GRAND TRUNK RAILWAY.
W. D. Robb, Supt. of Motive Power. Lima Loco. and Machine Co., Builders.

New Coal Mines in Canada.

The Grand Trunk Pacific and Canadian Northern railroads believe they have now solved the problem of a satisfactory steaming coal in the opening of the Jasper Park collieries and the Brazeau coal fields of southwestern Alberta. These properties are located about 200 miles west of Edmonton, immediately west of the sixth principal meridian, and on both sides of the Athabasca River. No development work has yet been done upon the north side, but a start has been made this year, so as to be ready for delivery by the time the Canadian Northern Railway tracks reach there. Considerable work has been done on the south side of the river, a mine being located alongside the Grand Trunk Pacific tracks, where the miners have tunneled over 2,000 ft. into the top seam and are now working down to a second seam.

The present output of this mine is 500 tons per day, which will be increased to 1,000 tons per day by the 1st of May. A temporary tipple and cleaning plant is being installed this year by the Roberts & Schaefer Co., of Chicago. The coal which is produced is semi-anthracite and gives splendid results on locomotives, for which purpose the entire output is being used, thus displacing Pennsylvania coal. It is the intention of the Grand Trunk Pacific to use Canadian coal entirely on all locomotives west of Watrous, Saskatchewan, as soon as the present supply of Pennsylvania coal is exhausted. It seems to us that this supply of coal will provide all fuel needed in Northwestern Canada.

Krupp Company Extending.

The great Krupp Iron Co., of Essen, Germany, has appeared on the industrial horizon of Norway. The Dundert Iron Ore Co., founded in 1892 to work the large ore deposits in Nordland, met with great difficulties, sinking $11,000,000 of Anglo-American capital. The property embraces nearly 100,000,000 tons of ore. After a prolonged suspension, work again has been begun at the mines, the Krupp company offering to invest $1,000,000. It is calculated that during the first year 200,000 tons of ore will be produced. Of this amount the Krupp concern wants half and its offer has been accepted. These are the largest mines in Norway and the prospect of their successful operation and expansion is of the deepest interest and importance to the country.

International Railway Fuel Association.

The business to be transacted by the above association at the annual convention, which will be held in Chicago, beginning May 22 next, will be the discussion of reports:

1. Standard Locomotive Performance Sheets, by R. Collatt.
2. Use of Anthracite for Locomotive Fuel, by T. S. Lloyd.
3. Drafting of Locomotives, by H. B. MacFarland.
4. Proper Method of Firing Locomotives, by D. C. Buell.
5. Inspection of Fuel, by J. E. Hitt and Glenn Warner.
6. Special Paper, by Prof. W. F. M. Goss.

Detailed information concerning the business of the convention may be obtained from Secretary-Treasurer D. B. Sebastian, Chicago, Ill.

The meeting promises to be more than usually interesting and the attendance will undoubtedly be the largest in the history of the association.

General Foremen's Department

The Norton Axle Grinding Machine.

Recent improvements in the Norton Axle Grinding Machine have attracted wide attention among railway men, and it is always of interest to observe the chief features that mark the development of improved machinery, not only in the superiority of the work, but in the equally important saving of time in the execution of the work. In this latter aspect a material reduction has been made in the grinding time, so much so that it is now a matter of regular accomplishment to grind three complete axles per hour. It may be stated briefly that one of the chief advantages in grinding axles, as in comparison with the older method of turning, is the fact that under any condition much material is saved. Those familiar with axle turning know that the average amount of material removed by turning will rarely be less than 1/16 in. from the diameter of the axle, and more frequently will amount to ⅛ in. This amount in almost every case is several times more than is actually necessary to make the axle perfectly round and true by grinding. Such being the case it is evident at the first glance that there would soon be an amount of saving in axles that would be the equivalent of a large amount of money and the fact that a number of railroads have already made exhaustive tests of the efficiency of the machine and adopted its use is sufficient proof of its surpassing merit.

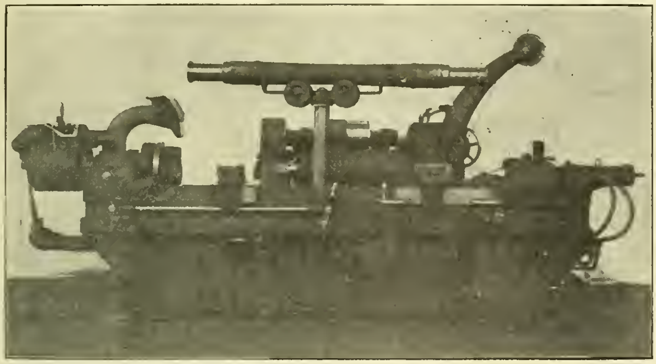


FIG. 1. GRINDING MACHINE WITH AXLE RAISED.

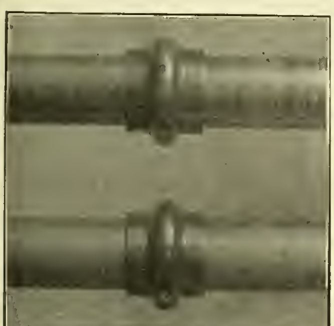


FIG. 2 SHOWING VARIATIONS IN FINISH.

In regard to the recent improvements on the machine it may be mentioned that after the attached crane has dropped the axle into the saddles provided for that purpose the placing of the axle on the centers requires no handling by the operator. He simply turns on the air, which centers the axle in the machine. The floating driving mechanism is then clamped to the end of the axle, and the grinding procceded with. When the grinding is completed on one end of the axle, the clamp is released, the air is turned on, which draws back the footstock, and the axle is immediately removed from both centers. Another air valve is opened by the operator and the axle is raised as shown in Fig. 1. The axle is then turned end for end by hand on a ball bearing pivot, and as the air is promptly allowed to escape from the lifting spindle, the axle falls into the saddles provided for that purpose. The operation of lifting into the centers, and after clamping the grinding of the second end of the axle is proceeded with.

It is not necessary to describe in detail the various appliances used on the machine. They are all simple and their use is readily acquired. The driving motor requires about 3 horse power. Motor and machine running together requires between 6 and 7 horsepower. The speed of the grinding wheel is 1,036 revolutions per minute.

A word may be said in regard to the finish of the work. It is not of the elaborately burnished kind. There is a grain on the surface due to the grain of the grinding wheel, and it has been repeatedly demonstrated that the surface as left by this special grinding wheel is a decided advantage to perfect lubrication. The absolute equality or straightness of the surface insures the regularity of the film of lubricant which is not possible on any bearing finished by cutting or filing or by emery friction. Even roller finished work does not approach the perfect cylindrical form of a ground grain surface.

Fig. 2 illustrates the variations of axle surfaces, the upper one showing a photograph of an axle finished in the usual way by turning, filing and polishing, and the lower showing the picture of a ground axle. Both samples were rubbed parallel with the axes with bronze rings of perfectly cylindrical bearings. The rubbing slightly abrades the high spots. The illustrations are genuine and convincing. And it is claimed by many that the roller finished work is subject to still more marked depressions than are shown by careful filing and finishing by an application of emery cloth.

Fig. 3 illustrates finished end of car axle, and it may be added that the machine is entirely adapted for use on car axles only, and the company, whose works are located at Worcester, Mass., are desirous that railway or other companies may send them axles so that they may demonstrate the results of their experiments and improvements in grinding machines, which undoubtedly appears to be a very valuable addition to the recent advance on the mechanical appliances used on railways, not to speak of the saving in time and labor.

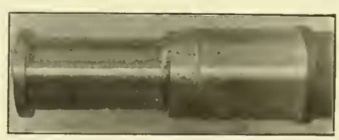


FIG. 3. FINISHED END OF AXLE.

Plan of General Railroad Repair Shops

By WILLIAM McINTOSH

The first essential for a railroad mechanical plant is space—not only for immediate requirements but for expansion as developments take place.

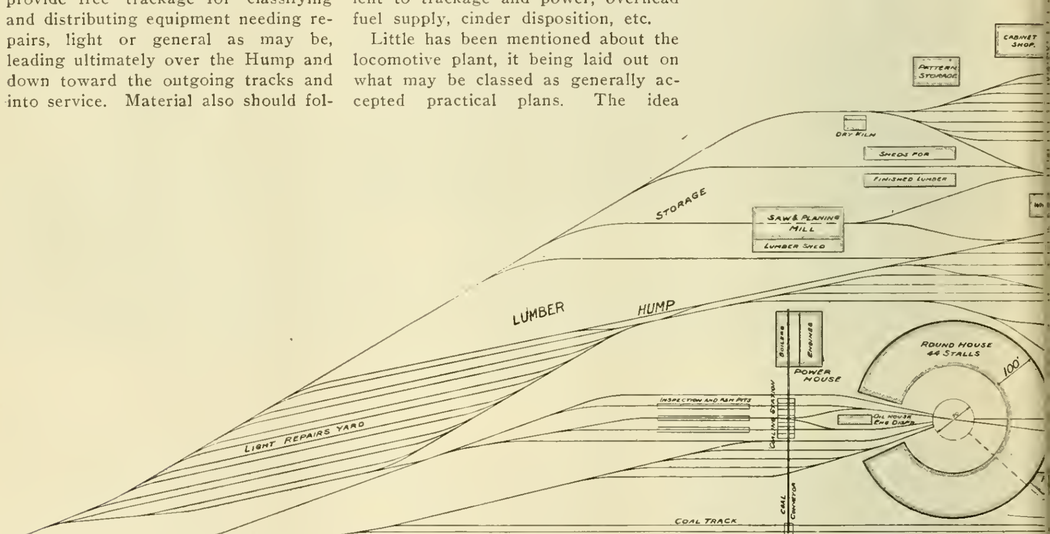
The "Hump" grade (an accepted necessity) can be easily secured by diverting material removed where excavating is being done for foundations—though a slight diverting of location might help much in that direction. It is desirable to secure ample building space with the use of as little ground space as the successful working of the plant will permit, providing always for freely meeting present needs, and allowing liberally for extension of some of the important buildings that might become inadequate to meet the growing demands. Receiving tracks should provide free trackage for classifying and distributing equipment needing repairs, light or general as may be, leading ultimately over the Hump and down toward the outgoing tracks and into service. Material also should follow along these lines, the idea being always to avoid return movements.

It will be observed that passenger car repair shops in this plan are not very extensive particularly the cabinet section. The planing mill, dry lumber shed, kiln, etc., are all contiguous to the transfer table and provide ready means for utilizing these conveniences to the utmost. Ample space is, however, available for larger buildings if required. A small cushion-cleaning and upholstering plant would be well located adjoining cabinet-shop with track connecting across transfer table to paint-shop if desired. Considerable room is needed to accommodate rough and finished wheels. This is provided. The freight car repair shop embraces an innovation in the way of a leg or gantry crane, running the entire length on one side in addition to cranes inside, where space is available for heavy steel car work as well as general work on the combination equipment now in use.

The arrangement of the overhead crane at either end of locomotive shop and connecting with round house, store house, scrap platform, and other shops, it will be observed, provides fully for handling all heavy material in and about the premises in the most economical and expeditious manner. No plan is laid down for a foundry, though there is good space for one near the power house where convenient to trackage and power, overhead fuel supply, cinder disposition, etc.

Little has been mentioned about the locomotive plant, it being laid out on what may be classed as generally accepted practical plans. The idea throughout is to provide liberally in the way of space and conveniences to meet daily requirements without embarrassment and economically. For it ordinarily follows that when there is greatest need for engines and cars in service shop work falls off more or less in proportion. Reduction of forces usually follow, resulting in the loss of good mechanics, trained helpers, handy men of one kind and another, lowering the standard and efficiency of the plant, for it requires no argument to prove that a trained employee is more serviceable to his employer, his family, the community and nation than when forced to become nomadic through no fault of his own.

Building, or rebuilding a few locomotives, passenger cars, freight or special cars during this period not only tends to maintain the property at a better standard, but places the esprit de corps on a much higher plane of loyalty—with peace and contentment reigning supreme, where otherwise there would be the feast or famine accompanying the time when extra hours were worked and forces increased to meet the requirements of the busy period followed by the shortened hours and idleness that usually results. Better ride an even keel by holding a regular force and cheerful loyal employees that regular employment would insure.



GROUND PLAN OF GE

Steel Wheels.

For many years in the history of American railways the subject of chilled cast iron wheels came up regularly for discussion. It was an interminable theme and gave rise to endless controversies, the most fertile cause for dispute having been the great diversity of patterns in use. We know of no member of the rolling stock family that could have been more easily reduced to uniformity, but it seemed that every attempt made by the Master Car Builders' Association to reduce the number of patterns made confusion more confounded.

It seems to us from the revelations made in an excellent paper on Steel Wheels, read at a meeting of the Western Railway Club by Mr. C. G. Bacon, Jr., of the Forged Steel Wheel Company, that railroads are rapidly drifting into the

same condition with steel wheels that they endured with cast iron wheels. In introducing the paper Mr. Bacon, among other things, said:

"I refer to the features of: (1) Hub diameter; (2) rim thickness, and (3) what I shall call mere 'dimension wheels.'

"The feature of hub diameter is of importance, because it controls the dimension of the hub wall thickness of the wheel when mounted, hence it is an interesting item entering into safety, and, for that reason, one which should receive the very greatest consideration. I must repeat that from the standpoint of a manufacturer I have no reason to object to enlarge hub diameters. Speaking for our own company, we can produce the enlarged hubs in the most successful and satisfactory manner, and every 25 or 50 pounds added to weight means a higher price, with proportionately greater profit, I hope. But as one of the engineers who, back in the days of the infancy of the solid steel wheel, when, primarily, as engineer of tests of the old Schoen Steel Wheel Company, and subsequently as wheel engineer with the Carnegie Steel Company, had much to do with the determination and advocacy of dimensions, I would like to question the advisability of disregarding our work on the strength of computations, or guesses, or meagre experience with a few wheels.

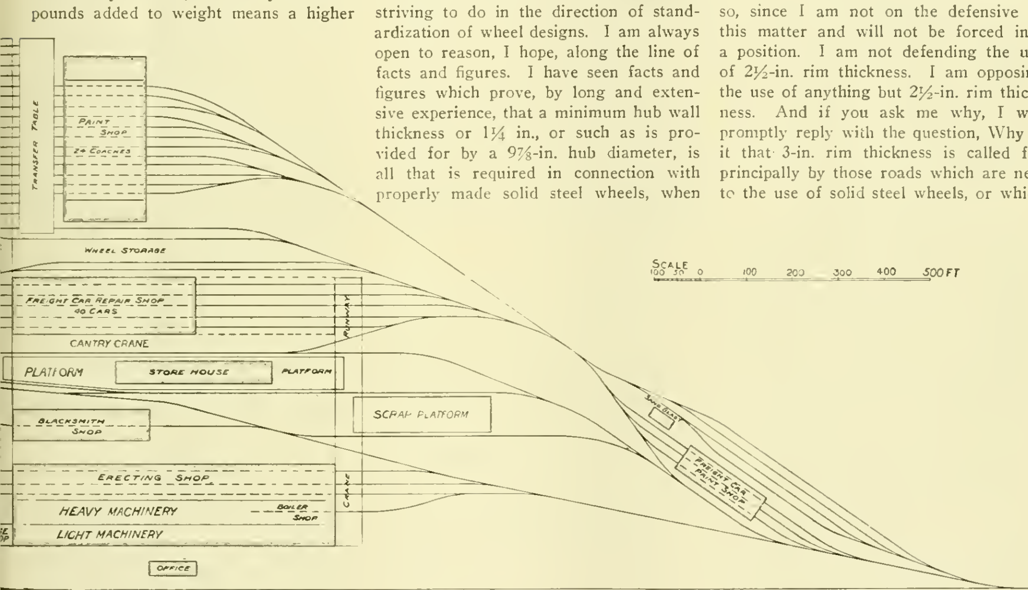
"You have all seen cases, as I have, where the mistake is made of theorizing and of then seeking substantiation. How much better it is in all cases where possible to enter upon consideration of a problem with a free mind, and to reason from effect to cause. Why guess, or theorize, or compute any longer to what hub diameter should be when the records of thousands, hundreds of thousands, of solid steel wheels which are rolling around the country answer the question in an unequivocal and unrefutable manner? What justification has a railroad official, new to the use of solid steel wheels, for predicting that 11-ins. hub diameter is required for 5½ ins. x 10 ins., and even 5 ins. x 9 ins. axles, when thousands of the same wheels with 9⅞-in. hub diameter, are in successful operation on neighboring roads.

"Gentlemen, it is just this sort of vagary, this variation in personalities which I hereinbefore have referred to, which complicates and retards the hard, earnest work which several of us are striving to do in the direction of standardization of wheel designs. I am always open to reason, I hope, along the line of facts and figures. I have seen facts and figures which prove, by long and extensive experience, that a minimum hub wall thickness or 1¼ in., or such as is provided for by a 9⅞-in. hub diameter, is all that is required in connection with properly made solid steel wheels, when mounted on wheel seats up to and including 7-ins. diameter, and no mere theory or presumptive assertions will cause me to view the matter in a different light. An incident which has come to my notice only since I prepared my paper will interest you. A certain manufacturer produced a few years ago quite a number of 33 ins. diameter solid steel wheels with 8⅝-ins. hub diameter, in accordance with the order of a railroad which wished to mount them upon 4¼ ins. x 8 ins. axles. A pair of these wheels was recently withdrawn from service under a tender for a defect in the tread of one of them after running somewhat over 70,000 miles, and you can perhaps imagine my feelings when I found them mounted on a 5½ ins. x 10 ins. axle, with 7 ins. diameter wheel-seat. Tight and true they were, though hub wall thickness was only 13/16 ins., and I asked skeptics to bear this evidence in mind when considering my advocacy of a 1¼ in. minimum hub wall thickness.

"On the matter of rim thickness I have said, and I repeat, that I really do not expect that what I have written will in itself necessarily make even one actual convert to the use of the 2½-in. rim thickness in place of 3 ins., but I have every right to expect that in view of the very decided stand I take in this matter, any and all of you who may hold contrary opinions at the moment will at least consider that it is best to investigate and study before taking issue with me. Proof of the correctness of my attitude is rather negative in form, and necessarily so, since I am not on the defensive in this matter and will not be forced into a position. I am not defending the use of 2½-in. rim thickness. I am opposing the use of anything but 2½-in. rim thickness. And if you ask me why, I will promptly reply with the question, Why is it that 3-in. rim thickness is called for principally by those roads which are new to the use of solid steel wheels, or which have had but limited experience with them, and that after years of broad experience in largest users of wheels of this kind have standardized on 2½-in. rim thickness?"

The paper itself, which is too long for our pages, is an urgent and intelligent plea in favor of uniformity, a sentiment which every railway man ought cordially to endorse.

It is natural that men in charge of mechanical work should incline to display individuality, but even that tendency should be kept subordinate to falling in with the views of the majority. The idea of give and take should prevail in deciding about forms.



AILROAD REPAIR SHOPS.

Questions Answered

VAUCLAIN COMPOUND.

163. A. G. Ennis, Texas, asks: If for any reason the high-pressure piston and piston rod had to be removed from cylinder out in the road, with a Vauclain four-cylinder compound locomotive, would it be possible to leave the valve connected and so retain the use of the low-pressure cylinder on that side of the engine? A.—Such a thing has been done and the locomotive run for a short distance at a slow speed, but it is not advisable to do so. After removing the piston the opening for the piston rod should be closed, the steam would then blow through the small, high-pressure cylinder and be used in the large low-pressure cylinder, but it may be readily understood that the necessity of maintaining an even balance in the pressure applied to the top and bottom of the crosshead, the piston rod in the low-pressure cylinder would be subjected to unusual stresses and might be broken with further damage to the locomotive.

VARIATIONS IN LEAD.

164. O. E. F., Hibbing, Minn., writes: (1) In your issue of March, Question 142, you described how a variation of lead was made with the American Locomotive Company's engine No. 50,000, but I would ask further that if the trunnion was on a line with the pin that connects the radius rod and the combination lever, would it not be possible to make the link with more curve and give the same variation in lead in both backward and forward motions? (2) If trunnion was above or below a line with the connection of the radius rod and combination lever, would it not give more lead in one gear than the other? A.—If the object aimed was to give a slight increase of lead in the forward motion of the engine, as in the case of the locomotive referred to both methods suggested could be adopted to have the desired effect, but the change would have the effect of distorting the action of the valve in the backward motion. Other undesirable complications would also arise in the amount of compression, and irregularity of exhaust opening that would more than nullify any little gain that could be made by the adoption of such complex variations.

REFRACTORY STEAM PUMP.

165. P. F., Sanborn, Ia., writes: We have a steam pump for filling boilers and it gives considerable trouble by stopping on the stroke towards the steam end. Kindly advise us how to remedy the defect. A.—In replying we would state that anyone making inquiries in regard to a pump which is not working satisfactorily should realize that it is very desirable to give such information as will enable the manufacturer to identify the pump; such as the shop number and size. In this case we can only make general suggestions; whereas, if we could know the history of the pump, its age, etc., we might offer remedies which would be of practical value through the inference we might draw.

When a pump comparatively new acts in the way referred to, the probability is that the reversing valve of the cover end has a chip or other obstruction between it and the seat in the bushing. But if the pump is old, it might be due to that, or the gasket at the cover end may be broken; or if a new gasket has been made the ports may not be properly cut out.

The reversing valve bushing may not be down to a good bearing; the steam chest plunger badly worn; the slide valve too loose in the plunger, or the slide valve and seat need truing up. The pump may also be a cheap imitation of the work of some good maker, in which case troubles may always be expected.

DIRECT OR INDIRECT MOTION.

BOILER FILLING AND CROSSHEAD BLOCKING.

166. J. L. Bessemer, Ala., asks: (1) Is an engine equipped with the Walschaerts valve gear a direct or indirect engine? (2) Can a dead engine being towed be filled with water? (3) Where would you block the crosshead of a Mogul Consolidation or Pacific type of locomotive? A.—(1) When the link block is beneath the center of the link it is a direct engine, and when the block is above the center of the link the motion of the valve becomes indirect. (2) If the pressure of steam in the locomotive that is being towed is sufficiently high to operate the injectors the boiler may be filled with water while moving. (3) The crosshead with attached piston should be moved to the extreme forward end of the stroke and a block of wood suitably fitted between the crosshead and guide yoke. The block may be held in place by wrought iron straps bolted to either side of the block, or if bolts are not available the block may be lashed in place by a rope or small chain.

BRAKE WORKS OPPOSITE.

167. J. M., Ft. Wayne, Ohio, writes: On an engine just out of the shop the No. 6 E. T. brake was found to be applied all the time the brake valve handle was in release or running position and when the handle was placed in service or emergency position the brake would release. I did not see this engine, but in your opinion could the No. 6 brake act in this manner, and what could cause it? A.—As the engine was just out of the shop it is probable that the air pipes were wrongly connected. If the brake pipe was in some manner connected with the brake cylinders and the brake pipe end coming in from the pilot was connected to the distributing valve where the brake cylinder pipe should be, the brake would act in the manner you mention.

There is a great deal of incorrect piping done in repair shops, and many ridiculous mistakes are made, but the engines are usually inspected and mistakes corrected before the engine is permitted to leave the shop.

PRESSURE IN BRAKE HOSE.

168. B. M., Brooklyn, N. Y., writes: I would like to know if there is any air pressure in the brake hose when the train brakes are applied, and what pressure is in the hose when the brakes are released? A.—With the automatic air brake the pressure in the brake pipe hose is 70 lbs. per square inch when the brakes are released and charged ready for an application. We reduce this pressure to apply the brake, 20 lbs. reduction gives a full application, leaving 50 lbs. in the brake pipe; however, all the pressure may be exhausted without producing any further braking effect, or under certain conditions the brake may be applied while there is 70 lbs. pressure in the brake pipe.

BRAKE RELEASES.

169. A. P. M., Charlotte, N. C., writes: In the next issue of the journal will you kindly explain where the defective part of the E. T. Westinghouse air brake equipment is when the brake releases as soon as the handle of either the automatic or independent valve handles are brought to lap position after an application? The answer will be appreciated by your subscribers in Charlotte. A.—As the main reservoir pressure will maintain the brake cylinder pressure as long as air pressure remains in the application cylinder, it is evident that if the brake releases when it is not desired it must be due to a fall of pressure through leakage in the application cylinder.

This leakage is usually found in the application cylinder pipe, at the application cylinder cover gasket or past the piston valve seat of the safety valve. The leakage could also be through defective threads on a reservoir stud or from the application cylinder pipe passages to the atmosphere

through defective gaskets or flaws in castings in the brake valves.

The leakage from the application cylinder might also be due to a combination of leakage from the pressure chamber and the release pipe, the first-mentioned one causing the equalizing portion to be returned to release position, connecting the application cylinder and the release pipe, the second leak then causing the release of the brake.

DISTRIBUTING VALVE DISORDER.

170. J. M., Ft. Wayne, Ohio, writes: Why is it that a No. 6 distributing valve apparently clean and in good condition will sometimes make a short, sharp exhaust of brake cylinder pressure after a service application. The brake does not release or brake cylinder pressure is not reduced, the exhaust valve merely opens and promptly closes a few seconds after the brake valve is lapped. A.—This action would indicate that there was a momentary fall in application cylinder pressure or due to some irregular action of the application piston, a higher pressure than was in the application cylinder had entered the brake cylinders. A dirty, gummy condition of the application piston might cause it to stick in application position for an instant and the momentary fall in application cylinder pressure which would produce this effect could be caused by a return of the equalizing piston to release position, which might be due to a leak of main reservoir pressure into the brake pipe or a leak of pressure chamber air to the atmosphere or possibly a leaky graduating valve or slide valve in the distributing valve.

The fall in pressure would occur as the application cylinder was connected with the release pipe by means of the exhaust cavity of the equalizing slide valve. To disconnect the release pipe or a gauge attached to the release pipe will show whether or not this disorder is due to a movement of the equalizing portion.

BRAKE FAILS TO APPLY.

171. A. J., Dayton, Ohio, writes: A hostler moving an engine claims that in attempting to apply a No. 6 E. T. brake, the brake would not apply with either brake valve in service position, but after the engine was stopped and the automatic brake valve placed in release position the brake applied, could such an action occur with the E. T. brake? A.—Yes, if the distributing valve has a quick-action cylinder cap and the stop-cock in the distributing valve supply pipe is closed.

When the brake valve handles are then in application position the automatic brake valve exhausts brake pipe pressure without main reservoir pressure reaching the brake cylinders and the reduction of brake pipe pressure permits the equalizing valve to travel its full stroke, opening the brake pipe to the brake cylinders past the emergency slide valve.

When the automatic brake valve is then returned to release position brake pipe pressure can enter the brake cylinders, and the independent valve in application position retains this brake cylinder pressure until it is exhausted by a movement of the independent valve.

BRAKE FAILS TO RELEASE.

172. J. M., Ft. Wayne, Ohio, writes: What is wrong with a No. 6 E. T. brake when the brake can be applied with either brake valve, but cannot be released with the automatic brake valve? A.—Assuming that the brake can only be released by moving the independent valve to release position, this failure to release with the automatic valve could be due either to a failure of the equalizing portion of the distributing valve to return to release position after an application or having returned, it could fail to exhaust the application cylinder pressure because of a closed release pipe or closed release pipe passage in one of the brake valves.

Failure of the equalizing portion to move could be due to a brake pipe obstruction or packing ring leakage, and if the action of the brake points to a closed release pipe, usually the quickest way to locate the point of stoppage is to disconnect the pipe near the automatic brake valve, as the stoppage usually occurs in the horizontal portion of the release pipe port through the rotary valve seat of the automatic brake valve.

Oil Fuel on Shipboard.

Oil weighs less than coal for the same heat energy, and it can be stored into considerably less space than coal, weight for weight, so that the employment of oil calls for very much less bunker capacity than coal. Moreover, places can be utilized for stowing oil which would not be applicable for holding coal, so that a considerable saving in space may be effected by employing oil as fuel, which may allow of a reduction in the light weight of a vessel for a given cargo-carrying capacity. In addition to that, a reduction in boiler capacity can be effected by employing oil, owing to the periodic cleaning of fires necessary with coal; and the absence of trimmings which is necessary with coal represents another advantage of oil fuel.

All these points contribute to the reduction of the initial cost of the vessel; and the oil fuel has the advantages as regards wages in the running costs. The cost of fuel, is however, relatively such an important question that unless oil can be sold at a price not greatly in excess of that of coal—the comparison being made on a thermal basis—oil has, in the writer's opinion, little chance of being extensively used for the propulsion of cargo boats, whether employed to generate steam or consumed in internal combustion engines. There is also an element of positive danger in the mass of combustible and possibly explosive oil stored on a steamship.

Collecting Rubber Milk.

People who have had experience in collecting the juice from which maple sugar is made would find themselves at home among the natives of Central America, who engage in collecting rubber sap.

The method followed, says a Consular Report, is to make V-shaped incisions in the trees and a narrow strip of bark taken off between the cuts to open up a way for the milk to run down. The rubber which is allowed to remain on the tree to coagulate is called scrap rubber. This coagulates within three to four days. It is then loosened by means of deer horns and stripped off, after which it is taken away on the backs of the rubber cutters in bales weighing from 25 to 50 lbs. The men frequently remain in the forests several months, and the rubber is then carried on mules to town.

Nice rubber capes and covering for cargo mules, as well as rubber bags, are made in Olancho, some of which are very attractive on account of their light weight. For this purpose ordinary unbleached muslin is used, which is covered with rubber and stuck together with rubber milk mixed with a little sulphur. One gallon of milk is sufficient to treat 2 yds. of cloth on one side and gives a covering about one thirty-second of an inch thick. The cloth is then placed in the sun or held over a fire to dry. It is also dipped in water to take out the stain of the sap, which gives the rubber a cream color. These capes and bags are sold for $4 to $6 each. They are made in the camps while the milk is fresh.

The numerous railway men interested in coal analyses will find an interesting paper called Technical Paper No. 8, published by the Bureau of Mines. It can be obtained free on application to the Director of the Bureau of Mines, Washington, D. C.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances.

Published Monthly by

ANGUS SINCLAIR CO.

114 Liberty Street, New York.

Telephone, 746 Rector.

Cable Address, "Locong," N. Y.
Glasgow, "Locoauto."

Business Department:

ANGUS SINCLAIR, D. E., Prest. and Treas.
JAMES KENNEDY, Vice-Prest.
HARRY A. KENNEY, Secy. and Gen. Mgr.

Editorial Department:

ANGUS SINCLAIR, D. E., Editor.
JAMES KENNEDY, Managing Editor.
ALLEN G. WOOD, Consulting Engineer.
GEO. W. KIEHM, Associate Editor.
A. J. MANSON, Associate Editor.

Boston Representative:

S. I. CARPENTER, 643 Old South Building, Boston, Mass.

London Representative:

THE LOCOMOTIVE PUBLISHING CO., Ltd., 3 Amen Corner, Paternoster Row, London, E.C.

Glasgow Representative:

A. F. SINCLAIR, 15 Manor Road, Bellahouston, Glasgow.

SUBSCRIPTION PRICE

$2.00 *per year,* $1.00 *for six months, postage paid in the United States, Canada and Mexico. For other parts of the world,* $2.50, *or ten shillings. Single copies,* 20 *cents. Remit by Express Money Order, Draft, Post Office Order or Registered Letter.*

Mailing address can be changed as often as necessary—always give old and new address, and if you subscribe in a club, state the name of the agent.

Please give prompt notice when your paper fails to reach you regularly.

Entered at the Post Office, New York, as Second-class Mail Matter.

Growth of Railways.

According to the statistical table compiled and published by the Bureau of Railway Economics the growth of American railways during the first ten years of the Twentieth Century has reached to 70 per cent. Much of this extraordinary gain is carefully tabulated and accounted for. Among the largest items in the increase of transportation are iron, coal, cereals and cement. The increase in iron ore production, and conveyed by railways, amounted to 25,000,000 tons. The increase in raw cotton was nearly 500,000 tons. These products, of course, are conveyed in various conditions of manufacture from point to point and represent many millions of tons in the total gain of railway traffic. In the item of cost of transportation it is interesting to observe that the charge for carrying one ton one mile in 1900 was .729 of a cent, and after ten years the amount had increased to .753. Wages and taxation and other costs have risen in a much larger proportion. In point of tractive power of locomotives, the force had more than doubled during the period referred to, and at the end of 1910 amounted to 1,588,894,480 lbs. The number of locomotives employed had risen from 37,663 in 1900, to 58,947 in 1910, showing an average tractive power of nearly 27,000 lbs. each.

In regard to passenger traffic in 1900, the number of revenue passengers was 576,831,251. In 1910 the figures were 871,689,199. The average number of miles traveled by each passenger in 1900 was 211. In 1910 it was 351. The cost to passengers is shown to be slightly less than two cents a mile, and shows a small reduction during the period under investigation. The number of employees has increased during the same period about 50 per cent. In round numbers about 1,000,000 were employed in railways in 1900, and about 1,500,000 in 1910.

The most striking features in the report are the outstanding facts that while the volume of traffic, the convenience and comfort, the rapidity of transportation, the safety of passengers, the security of property and the promptness of delivery has increased, the cost has slightly diminished. If we take into consideration the fact that wages, mechanical appliances, taxes and every conceivable kind of charges have considerably increased we cannot do other than admit that the management of the railways reflects the highest credit on American enterprise and ingenuity, and we are convinced that a more liberal policy on the part of the government as exhibited by the work of some of the commissioners, would be proper and becoming.

Valves.

In the course of long use the name valve has come to be applied only to a device for closing a small aperture or opening. Originally the word valve meant a door and was so used in connection with temples, churches and other imposing buildings. There is reason for believing that many ancient temples were equipped with self-closing doors operated by steam which intensified the mystery connected with them.

The most ancient appliance now regarded as a valve, performing the functions of closing and opening an aperture, is used in the bellows. This implement was employed by the persons who first smelted metal, so its use is very old.

Among the discoveries of Egyptian monuments, figures were found on a tomb at Thebes which bears the name of Thothmes III, one of the Pharaohs, who was contemporary with the Scripture Moses. There are figures on the tomb which illustrate blacksmiths at work using bellows provided with self-acting valves.

In a fire engine described by Hero of Alexandria in his treatise on mechanism known as the "Spiritalia," two metallic pistons are used, and spindle valves with guards to prevent the latter from rising too far. Another apparatus illustrated in the same work is the lustral vase which was used in the Temple of Isis, in Egypt, many centuries before the Christian era began. The vase contained holy water, and was placed at the entrance to the temple. Before a worshipper could enter a libation of holy water had to be procured. This was done by dropping coins through a slot at the top of the vase, and they fell into a dish, raising the spindle valve inside the cylinder, permitting a small quantity of water to run out through the pipe connected with the valve.

Besides illustrating a very ancient valve, this vase shows what may be regarded as the original penny-in-the-slot apparatus. It also shows the first form of piston valve. Although the matter has little bearing on valve construction, the lustral vase proves that holy water was used in religious rites long before Christianity.

The Atom a Delusion.

Nearly all students of combustion and other subjects which involve some knowledge of chemistry are taught that the smallest entity of matter is the atom. Ancient philosophers held peculiar views about the intricate subdivision of matter, but it was for John Dalton, an English chemist, to enunciate what is known as the Atomic Theory of Matter. That was a very satisfactory theory until something more positive was discovered, and according to Electricity this has been accomplished, and comments:

A review of the facts leads us to the belief that all forms of matter are inextricably associated with static electricity; that a modification in the physical conformation of a mass of matter is due to electrical changes which give rise to many of the effects familiar to laymen and scientists alike. In addition, the chemical changes which occur, in the form of violent reactions or slow processes of decomposition, are inherently electrical in character, and in many instances where scientific analysis has paved the way might be anticipated in a purely mathematical and electrical manner. Chemistry, then, is becoming a subject in which a new atom is taking the place of the old. The atom of Dalton is being replaced by a center of electrical

energy in a state of intense rotation and vibration.

In fact, instead of the old atom we are face to face with an infinitesimal planetary system. That which has hitherto been regarded as merely matter now appears as identical with electricity. We have Ramsay, Crookes, Van T'Hoff and Arrhenius, the greatest chemists and electro-chemists in the world, to point out on the scientific horizon the new world of chemistry, toward which the tide of thought is rapidly setting. To consider a charge of electricity concentrated on a point of matter of the most minute proportions is to realize that a center of electrical attraction has been created to which the action of a pith ball to a charged glass rod is as light and delicate as the down on a butterfly's wing. Charges thus concentrated become centers of powerful attractive forces, and the simplest experiments in chemistry have thus far strongly proved that chemical affinity and valency, the last particularly, are due to just such a condition of affairs—electricity associated with the atoms. This, then, brings us back to our original question, in which we ask: Is chemistry a department of electricity?

The Man Who Does Not Read.

He is very likely to be a little conceited and think that he knows just how to do things without help from any outside source.

He is inclined to think disparagingly of a "book" engineer or machinist, as he sees fit to call the man who reads and tries to keep posted and up with the times.

He is generally the first to condemn any new appliance that comes out. When the air brake was first introduced, we heard such an engineer denounce it as a "nuisance, and too much trouble; the engineer had enough to see to, without being brakeman."

When the automatic air brake first came out, the construction of the air pump was a great puzzle to the ordinary engineer and repair machanic. At that time Allan McDuff, afterwards general foreman of the B., C. R. & N. Railway shops at Cedar Rapids, Ia., had charge of all mechanical mysteries. To solve the air pump details he consulted Appleton's Encyclopedia of Applied Mechanics and gained wisdom. By following up what he had learned in that book he became the best-informed man in Iowa concerning air brakes.

Not long since, one of our Western roads applied a few sight-feed lubricators to some of their locomotives. The man whose duty it was to explain to the engineer how to operate them had not carefully read the directions sent with the cups, and so was totally ignorant of one very important valve, the intelligent use of which was essential to the successful working of the lubricator. The manufacturer had to send out an expert to save the reputation of one of the best appliances ever added to a locomotive.

A man who reads was placed in charge of one of our modern automatic stationary engines. The valve, and what was inside of the steam chest and cylinder, he had never seen, and, of course, knew nothing of its construction. He sent to the builder and procured a "descriptive catalogue," and in one evening, by its perusal, he obtained a good idea of what was going on inside of that engine.

The man who does not read wonders what is inside, but does not find out until it is torn apart, and even then he does not get the builder's idea, and know why it is so made. It takes him weeks, months, or years to find out what a few hours of study would enable him to ascertain.

How many inventors spend long sleepless nights in "getting up" something, and then find out that the thing won't work, because it is not constructed in accordance with the laws of mechanics.

We know of a man holding a high official position on one of the largest railroads of the West who built, at a great expense to the company, a hydraulic pile-driver, which, with two men, was to do the work of a ten-horsepower engine. He had seen the tremendous force exerted by a hydrostatic wheel press, and concluded that this was just the power to lift a pile-driver ram, and as the pump was so small, two men could easily work it. It is needless to add that the result was a failure, and an addition to the scrap heap.

This is a fast age, and the man who expects to keep pace with the times must not expect to find out everything by the slow coach of experience, but take advantage of the delving of others, as it may be condensed in their writings. It saves time, hard work and many mistakes.

Revision of Patent Laws.

A bill has been introduced into both houses of Congress last month, looking toward a revision of the patent laws. It will be generally admitted by those familiar with the subject that the laws in regard to patents are capable of amendment. Whether the measures proposed embrace an earnest desire on the part of statesmen qualified to deal with the subject, or merely a move to secure extra work for a special committee during the recess of Congress remains to be seen.

Perhaps the most important proposal, appearing in a casual glance at the new measure is a proposition that if a patented invention is not used within a period of four years after the securing of a patent, the proprietor of the article patented may be by law compelled to allow its use on such terms as may be deemed equitable by a district court. It seems singular that such a condition could exist, but we have known instances where some clever inventor had disposed of his invention to some other inventor or company holding similar inventions and the work of the second party would be held in abeyance pending the exploitation of the devices already on the market. If the proposed amendments to the patent laws can be made to remedy an evil of this kind or of any other kind, by all means let us have the remedy.

It is a singular circumstance that only a few inventors reap the full reward of their inventions. The more valuable the invention is the more certain the inventor seems to be foredoomed to endless litigation in defense of his work. This, to a sensitive nature, is a hard and bitter experience, and doubtless tends to delay if not to chill altogether the inventive ability which under happier conditions might produce new work that would be of benefit to humanity. In the realm of art, as in literature and science, invention is the highest intellectual faculty, but without encouragement it perishes. We live in an age of marvelous inventions, and it becomes our legislative assemblies to deliberate wisely and well on the safeguarding and encouraging of the work of those amongst us who are capable of projecting their minds into the undiscovered regions of scientific enquiry and experiment, to the end that the burden of the world's work may be lightened, and the world's benefactors receive a fuller reward for their labors.

Erie Regeneration.

We hardly think that any railroad in the world has encountered so many vicissitudes as the Erie Railroad. When the railroad was first projected, in 1831, it was intended to be the greatest railroad in the world with termini on the Hudson River, near New York, and at Dunkirk, on Lake Erie, a stretch of over 400 miles.

For the first few years of its history the Erie Railroad enterprise was the prey of politicians and the victim of Erie Canal stockholders. New York City business men considered that in the Erie Canal they commanded the greatest possible artery of transportation towards the undeveloped territory west of the Great Lakes, and instead of helping any new project for producing increased methods of transport, they threw every possible obstacle in the way, and cheated the southern counties of New York State out of a promised great highway.

The first Erie Railroad Company was organized in 1833, and construction begun that eighteen years later, in 1851, brought railroad cars from Piedmont to Dunkirk. The building of these 400 miles of railroad through a territory that was largely virgin forest, forms one of the most stirring industrial romances the world has ever seen. The wild beasts of the forest that made the construction of the railroad dangerous, were not half so hard to vanquish or hold at bay as the wild beasts of the financial world.

In the progress of enterprise the Erie Railroad came to be one thousand miles long, extending from New York to Chicago, with branching lines sufficient to make 2,112 miles in the first year of this century. The vitals had been stolen out of the property years before and succeeding managements had struggled along doing the best they could, but poorly enough, for they seldom had money to carry out necessary improvements.

This was the state of matters on the Erie in 1901 when Fred. D. Underwood accepted the position of president. The road had become the butt of the humorists' wicked jokes for want of regularily and for other peculiarities. Mr. Underwood went vigorously to work. In some mysterious manner he surrounded himself with the ablest operating railway officials in the country and by degrees the laugh and the jibe went elsewhere. An alluring spectacle about the Erie is that the *esprit de corps* of the road is the warmest to be found anywhere and that always has a beneficent influence in train operating.

The proof of the pudding is in the eating. When all other trunk lines tasted disaster during the past winter, the Erie passed through the struggle with scarce a scratch. The *Wall Street Journal*, which is generally wise on Erie matters, has said lately:

"The management of the Erie has been authorized to issue $10,000,000 of 5 per cent. notes running three years, the proceeds to be added to a like amount from current income, and the total used to complete the double-tracking of the main line to Chicago. This means that about 190 miles of double-track will be laid on the Chicago and Erie division and about 120 miles elsewhere. It is generally conceded that when this work is finished (about two years hence) the Erie will possess one of the lowest-grade roads of the standard trunk lines between New York and Chicago. So favorable will be the grades that the Erie will be able to bring into New York a 2,000-ton train load without breaking it up at any point on the way.

"It is believed that this improvement will increase the carrying capacity of the Erie by one-third, at the same time greatly reducing operating costs. The revenues in consequence will, it is estimated, increase about $5,000,000 during the first year after the road begins to receive the benefits of the improvement, and the Erie will then be able, not only to pay dividends on the two classes of preferred stock, but on the common also. The Erie already last year earned dividends on its three classes of stock, but the money was more wisely expended in improvements. At the end of two years, it is expected that dividends can and will be paid. When the improvements are completed, the company will have a six-track line from New York to Ridgewood, N. J., a four-track line to Port Jervis, and two tracks thence all the way to Chicago, with stretches of three and four tracks at various intermediate points. The following statement shows the increases which have taken place in the gross and net earnings of the Erie in the past ten years:

	Mileage.	Gross.	Net.
1911.....	2,265	$56,649,908	$17,794,981
1907.....	2,151	53,914,827	17,190,587
1906.....	2,151	50,002,634	15,147,302
1905.....	2,151	45,724,738	13,573,177
1903.....	2,153	45,830,413	16,876,425
1902.....	2,154	40,894,434	13,988,901
1901.....	2,112	39,102,302	13,260,801

"The Erie today is declared to be handling its freight traffic as cheaply and quickly as the Pennsylvania. Compared with other standard trunk lines, it is showing still better operating performances. So quick are its deliveries that it now has about 90 per cent. of the deciduous and citrous fruit traffic that comes from California to New York by way of Chicago, and yet the Erie has had far less money to spend on its property than any of the other lines. During the past six years its remarkable improvements in operating efficiency have been secured by the expenditure of only $11,000,000, chargeable to capital account. At the same time it charged to income used for improvements $6,800,000."

Sinking of the Titanic.

The greatest calamity experienced in modern times happened on April 15, when the steamship *Titanic* went to the bottom of the Atlantic Ocean near the Newfoundland banks, carrying 1,475 people to a watery grave. The disaster was undoubtedly due to the prevailing craze for high speed, which has sacrificed so many human lives by land and sea. From what the writer learned through the experience of two years in the engine room of Atlantic steamers forty years ago, he is forced to the conclusion that the loss of the *Titanic* was due to gross reckless carelessness.

The *Titanic* had a registered tonnage of 45,000, with a tonnage displacement of 64,000. Her length over all was 882 ft. 6 ins., and breadth over all 92 ft. 6 ins. Her height, over the boat deck was 94 ft., and from keel to top of captain's house 105 ft. 7 ins. The funnels towered 81 ft. 6 ins. above the deck, making the total height of the vessel, from keel to top of funnels, 175 ft. There were 11 steel decks, and in the hull were 15 independent water tight bulkheads.

That division of the ship into water tight compartments was made the basis of the theory that the ship was unsinkable, and no doubt promoted recklessness in pushing her through the water. In the long ago ice was considered the greatest peril of Atlantic navigation, and all that care and vigilance could accomplish was done to detect the presence of ice in time to avoid striking it. The presence of icebergs is indicated by the temperature of the ocean from eight to ten miles away from the frozen mass. To obtain full benefit from this natural warning, we took the temperature every twenty minutes or less on ships making from fourteen to sixteen knots an hour. Captain Smith, of the *Titanic*, did not require to instruct the engineers to watch the temperature of the ocean. He had been notified that icebergs were in his way, and was sending the information over sea and land by Marconi wireless telegraphy, yet he was so determined to make a notable maiden voyage for the vessel that he rammed her ahead reckless of consequences.

We have in railway life certain engineers known as chance takers who will sacrifice safety to speed, and they often create disaster. We think that Captain Smith, commander of the *Titanic*, has earned the title of Superlative Chancetaker. A parallel railway case would be for an engineer to rush along without reduction of speed when he was notified that a bridge in front was burning.

There is reason to believe, however, that Captain Smith was not acting entirely on his own judgment, for there was on board J. Bruce Ismay, one of the owners and managing directors of the White Star Line, who seemed to dominate the captain and everything on board until the crash came, when he sneaked into one of the life boats and saved his worthless carcass while hundreds of better men went down to death.

A scandalous incident of the catastrophe was the scarcity of life boats, for means of rescue was provided for only about one-third of the people on board. This was due in a great measure to the well-advertised fallacy that the vessel was unsinkable. It is very melancholy to reflect that none of the high class ocean liners are better provided with means of rescue should any accident happen to send the vessel to the bottom. With so many vessels rushing along in all sorts of weather with ice risks and collision jeopardies, it would not be surprising to find the disaster of the *Titanic* duplicated any day.

Attention!! Answer Circulars of Inquiry.

Nearly all members of engineering, mechanical and other technical associations after attending conventions make up their minds to answer the circulars sent out by the chairmen of committees and to give earnest help with the work of collecting information to make the basis of good reports. That is a fine specimen of the good intentions that have so often gone to the paving the place where good intentions flourish.

Well, the ordinary member goes home and when the circulars of inquiry from the various chairmen begin to arrive, he carefully places them in convenient pigeon holes where they will be handy to find when he has time to formulate the answers. In most cases that time never comes, and the circulars accumulate till the convention has come and gone, then they are thrown out to make room for another repetition.

We are here publishing particulars of all the subjects to come before the Master Mechanics' Convention, and think it is a seasonable time to urge members to spend a few hours answering them. We have found it to be excellent educational experience the studying of subjects with a view of answering circulars, and we are certain that others would derive profit from similar experience if they will only try it. In this case we are making a special appeal on behalf of the Master Mechanics' Association, but the same reason applies for the Traveling Engineers, the General Shop Foremen's Association and of others. It will be noted that the subjects embrace many of the leading questions that are engaging the attention of railway men at the present time.

COMMITTEES SELECTED FOR THE 1912 MASTER MECHANICS' CONVENTION.

1. Advisory Technical:

G. W. Wildin (chairman), M. S., N. Y. N. H. & H. R. R., New Haven, Conn.; A. W. Gibbs, C. M. E., Penna. R. R., Philadelphia, Pa.; W. A. Nettleton, G. S. M. P., C. R. I. & P. Ry., Chicago, Ill.

2. Revision of Standards:

T. W. Demarest (chairman), S. M. P., Penna. Lines, Ft. Wayne, Ind.; J. D. Harris, Roland Park, Md.; W. E. Dunham, Supr. M. P. & M., C. & N. W. Ry., Winona, Minn.

3. Mechanical Stokers:

T. Rumney (chairman), G. M. S., Erie R. R., New York City; E. D. Nelson, Engr. Tests, Penna. R. R., Altoona, Pa.; C. E. Gossett, M. M., Minn. & St. Louis R. R., Minneapolis, Minn.; J. A. Carney, S. S., C. B. & Q. R. R., W. Burlington, Iowa; T. O. Sechrist, M. M., C. N. O. & T. P. Ry., Somerset, Ky.; S. K. Dickerson, A. S. M. P., L. S. & M. S. Ry., Cleveland, Ohio; Geo. Hodgins, 114 Liberty street, New York City.

4. Specifications for Cast-Steel Locomotive Frames:

C. B. Young (chairman), M. E., C. B. & Q. R. R., Chicago, Ill.; E. W. Pratt, A. S. M. P., C. & N. W. Ry., Chicago, Ill.; R. K. Reading, S. M. P., Penna. R. R., Buffalo, N. Y.; O. C. Cromwell, M. E., Balto. & Ohio R. R., Baltimore, Md.; C. E. Fuller, A. G. M., Union Pacific R. R., Omaha, Neb.; L. R. Pomeroy, J. G. White & Co., New York City.

5. Main and Side Rods:

W. F. Kiesel, Jr., A. M. E., Penna. R. R., Altoona, Pa.; H. Bartlett, G. S. M. P., Boston & Maine R. R., Boston, Mass.; G. Lanza, Mass. Institute of Technology, Boston, Mass.; H. B. Hunt, care American Locomotive Company, Chicago, Ill.; W. E. Dunham, Supervisor M. P. & M., C. & N. W. Ry., Winona, Minn.

6. Consolidation:

D. F. Crawford (chairman), G. S. M. P., Penna. Lines, Pittsburgh, Pa.; H. H. Vaughan, Asst. to V. P., Can. Pac. Ry., Montreal, Can.; G. W. Wildin, M. S., N. Y. N. H. & H. R. R., New Haven Conn.

7. Safety Valves:

W. J. Tollerton (chairman), A. G. S. M. P., C. R. I. & P. Ry., Chicago, Ill.; I. B. Thomas, S. M. P., Penna. R. R., Williamsport, Pa.; W. D. Robb, Supt. M. P., Grand Trunk Ry., Montreal, Can.; Prof. E. C. Schmidt, Univ. of Illinois, Urbana, Ill.

8. Safety Appliances:

H. T. Bentley, P. A. S. M. P., C. & N. W. Ry., Chicago, Ill.; M. K. Barnum, G. S. M. P., Ill. Cent. R. R., Chicago, Ill.; C. B. Young, M. E., C. B. & Q. R. R., Chicago, Ill.

9. Design, Construction and Maintenance of Locomotive Boilers:

D. R. MacBain, S. M. P., L. S. & M. S. Ry., Cleveland, Ohio; C. E. Chambers, S. M. P., C. R. R. of N. J., Jersey City, N. J.; T. W. Demarest, S. M. P., Penna. Lines West, Ft. Wayne, Ind.; F. H. Clark, G. S. M. P., B. & O. R. R., Baltimore, Md.; R. E. Smith, G. S. M. P., A. C. L. R. R., Wilmington, Del.; E. W. Pratt, A. S. M. P., C. & N. W. Ry., Chicago, Ill.; J. Snowden Bell, 149 Broadway, New York City.

10. Contour of Tires:

W. C. A. Henry (chairman), S. M. P., Penna. Lines, Columbus, Ohio; J. A. Pilcher, M. E., N. & W. Ry., Roanoke, Va.; O. C. Cromwell, M. E., Balto. & Ohio R. R., Baltimore, Md.; H. C. Oviatt, M. M., N. Y. N. H. & H. R. R., E. Hartford, Conn.; O. M. Foster, M. M., L. S. & M. S. Ry., Elkhart, Ind.; G. W. Seidel, S. S., C. R. I. & P. R. R., Silvis, Ill.

11. Steel Tires:

L. R. Johnson (chairman), A. S. M. P., Can. Pac. Ry., Montreal, Can.; J. R. Onderdonk, Engr. Tests, Balto. & Ohio R. R., Baltimore, Md.; C. H. Hogan, D. S. M. P., N. Y. C. & H. R. R. R., Depew, N. Y.; R. L. Ettenger, C. M. E., Southern Ry., Washington, D. C.; L. H. Turner, S. M. P., P. & L. E. R. R., Pittsburgh, Pa.

12. Flange Lubrication:

M. H. Haig (chairman), M. E., A. T. & S. F. Ry., Topeka, Kan.; T. W. Heintzleman, S. M. P., So. Pac. Co., Sacramento, Cal.; D. J. Redding, M. M., P. & L. E. R. R., McKees Rocks, Pa.; A. Kearney, A. S. M. P., N. & W. R. R., Roanoke, Va.; W. C. Hayes, S. L. O., Erie R. R., New York City.

13. Minimum Requirements for Headlights:

D. F. Crawford (chairman), G. S. M. P., Penna. Lines, Pittsburgh, Pa.; A. R. Ayers, A. M. M., L. S. & M. S. Ry., Elkhart, Ind.; C. H. Rae, G. M. M., L. & N. R. R., Louisville, Ky.; J. W. Small, S. M., Mo. Pacific Ry., St. Louis, Mo.; F. A. Torrey, G. S. M. P., C. B. & Q. Ry., Chicago, Ill.

14. Standardization of Tinware:

A. J. Poole, S. M. P., Seaboard Air Line Ry., Portsmouth, Va.; M. D. Franey, A. M. M., L. S. & M. S. Ry., Collinwood, Ohio; J. C. Mengel, M. M., Penna. R. R., Altoona, Pa.

15. Maintenance of Superheater Locomotives:

R. D. Smith, S. M. P., Boston & Albany R. R., Boston, Mass.; W. H. Bradley, M. M., C. & N. W. Ry., Clinton, Iowa; H. H. Vaughan, Asst. to V. P., Can. Pac. Ry., Montreal, Can.; Jas. Chidley, M. M., L. S. & M. S. Ry., Collinwood, Ohio; J. B. Kilpatrick, S. M. P., C. R. I. & P. Ry., Davenport, Iowa.

16. Arrangements:

H. T. Bentley, P. A. S. M. P., C. & N. W. Ry., Chicago, Ill.

Railroads and Engineers Agree to Mediation.

For several weeks last month grave fears were aroused that the dispute between the railroads East of Chicago and the Brotherhood of Locomotive Engineers might bring about a strike. The representatives of the Engineers, with Grand Chief Warren S. Stone heading the fight, had asked for a raise of pay and the adjustment of certain grievances. Representatives of the different railroads held a variety of meetings to discuss the engineers' demands, and finally returned a positive refusal. Meanwhile, the engineers had taken a vote on the question of taking the answer of the railroads meekly or of going out on strike, and strike sentiment ruled by a great majority.

When an open conflict seemed about to begin Martin A. Knapp, presiding judge of the United States Court of Commerce, and Charles P. Neill, United States Commissioner of Labor, stepped into the arena and offered their services as mediators. Both sides accepted the offer, and there are now prospects of amicable adjustment of the differences between the engineers and their employers. Should mediation fail there is still a chance for arbitration under what is known as the Erdman law. This may lead to all disputes between transportation companies and their employees being settled by arbitration.

Wireless Train Control.

The Prentice automatic wireless train control system is being demonstrated under the most favorable auspices at their New York laboratory. The complete apparatus is in operation daily and is attracting wide attention among the members of the engineering societies generally and among leading railway men particularly. It will be remembered that the wireless control system was very fully described in the March issue of RAILWAY AND LOCOMOTIVE ENGINEERING, and we have been gratified to observe that our description has been extensively copied in the leading newspapres throughout the country. We have heard many eminent men speak of the device in the highest terms, and a general feeling of assurance in its applicability and reliability is being expressed by all who have given the matter attention. The recent phenomenal increase in the value of Marconi stock is an illustration of the possibilities that lie within the scope of the application of this new and amazing use to which wireless electricity may be put, and we shall be surprised if the Prentice wireless train control system does not speedily revolutionize railroad traffic control as the Marconi system has changed or rather created a new method of signaling at sea.

Catechism of Railroad Operation

By Angus Sinclair

QUESTIONS AND ANSWERS.

Third Series Continued.

175. What would you do in case the frame of an engine you were running broke?

A. For a frame broken ahead of main driver would disconnect the valve stem on disabled side, cover ports and leave main rod in place; then bring the engine in light on the good side. If the break was behind the main driver, would take down side rods on rear section only on a consolidation engine. With a mogul type and the knuckle pin or forward section would take down all side rods.

176. What action would be necessary should key come out of frame splice or cylinder saddle?

A. If the key was not lost would try to put it back in place with liners to hold it snugly. It is generally easy to find something to replace frame key but saddle key is different. In case of a lost saddle key it is generally the better plan to disconnect that side.

177. What remedy would be necessary in case a center casting broke.

A. With the ordinary 4-wheel engine truck, a short rail put across the top of the truck equalizers and under the center casting will bring the engine to the terminus in safety. In the absence of rails would use hard wood blocking over truck frame and under cylinder saddles. It would be necessary to proceed slowly and with much care.

178. What repairs would be necessary for a broken driving brass?

A. The most convenient way to overcome this defect with modern engines is to run the wheel upon an Alexander wrecking frog or wedge or block up between the frame and spring saddle to take as much weight as possible off the box. With an engine having underhung springs, there is no saddle to block under, so a different procedure is necessary. In such a case I would place a jack under equalizer nearest to the broken brass, then block the other end between frame and equalizer and remove the spring if possible.

179. What should be done with a broken equalizer between forward driver and engine truck of a mogul or consolidation engine?

A. If the break is at the forward end I would jack up that end as high as possible, lay a rail across the frame and secure the equalizer with a chain to the rail. If at the rear end or the hanger connecting the equalizer to the cross equalizer is broken, would raise the equalizer the same as in the other case and secure it with a chain to a rail placed upon the frame behind the cylinders. Then I would bring the cross equalizer down from the boiler and block between the boiler and cross equalizer.

180. What would be done with a broken engine truck wheel or axle?

A. If it was a broken wheel or tire, would jack up the front of the engine to take the weight off the truck. Then take out the cellar and block with a V-shaped block of wood between the axle and pedestal brace. That being done would jack up the truck frame high enough to allow broken wheel to clear the rail and secure the truck to the engine frame with a chain.

181. What should be done if the piston, crosshead connecting rod or crank pin is bent or broken?

A. If the piston is broken or the piston rod bent, it is necessary to remove both, disconnect the valve stem only and cover ports.

With a broken crosshead or bent or broken main rod, the main rod would have to come down. Then push the piston ahead or back—which depends upon the type of engine—and move valve to admit steam against piston in the direction in which it is desired to hold the piston, clamp valve and block the crosshead as an additional precaution.

With a broken crank pin the main rod would not have to come down but could rest on the valve yoke or guide. It would be necessary to ascertain in case a piston valve was used whether it gives inside or outside admission before shifting the valve, as the movement of the former is directly opposite to that of the latter.

182. How can an engine be brought in with a broken front end?

A. We have repeatedly seen engines with fractured front ends fixed up with boards and a barrel performing the duty of smokestack. That is a tedious job and should not be undertaken where trains are numerous.

183. How can it be known whether the wedges are set up too tight and the driving box sticks? In what manner can they be pulled down?

A. If the wedges are set up too light, the boxes will heat, the engine will ride hard and have a rough, jerky up and down motion.

Drawing down the wedge bolt snug and running the wheels upon blocks will generally bring down a stuck wedge as the box drops down. A little oil or kerosene between wedge and pedestal will often help.

184. In case the engine jumped the track and lifting jacks were not at hand, how would you put the wheels upon the rails?

A. Would use Alexander car replacer. If that useful aid was not available would use hardwood blocks and fish plates.

185. What are the most serious objections to blows in valves and pistons?

A. These affect the steaming qualities of an engine and are often very difficult to locate.

186. How can the blowing of steam past a valve, cylinder packing or valve strip be distinguished and located?

A. When the valve has been placed to cover both steam ports and no steam escapes from cylinder cocks but escapes through exhaust port to stack, it indicates that valve strips are down or broken and permit steam to escape to the steam port through small hole in valve.

187. What is likely to confound a valve blow with cylinder packing blow?

A. The most prolific cause for this confusion is improper adjustment of the balance plate. The distance between the balance plate and the valve of the Richardson balanced valve should never exceed 1/8 inch. When this distance is exceeded, broken balance strip springs become common, particularly when the springs are of inferior quality. When this happens the balance strip settles down in the valve groove, steam passes over it and out of the small hole on top of the valve into the exhaust cavity.

188. For what purpose is a hole drilled on top of a balanced valves?

A. Under certain conditions steam accumulates in the balance recess and that hole enables it to escape.

189. What condition indicates a cut valve?

A. If valve covers ports, and steam appears at both cylinder cocks, it indicates a cut valve or seat.

190. What action of steam use manifests broken piston rings or cut cylinder?

A. If steam escapes from the cylinder cocks at both ends of the cylinder at the same time, it indicates broken packing rings or cut cylinder.

191. What indicates that a valve is blowing?

A. A valve blow continues during the entire travel of the valve, while a cylinder blow is strongest when the piston is at the beginning of the stroke and gradually diminishes until the cut off takes place as piston approaches the end of its stroke.

192. If a simple engine should blow badly when steam was applied, what would you think was the matter?

A. A cocked valve—that is a valve that was off its seat.

193. What would you do to remedy a cock valve?

A. Jerk the reverse lever quickly. If that failed to replace the valve upon its seat, would strike the valve stem repeatedly with piece of wood.

In connection with accidents to running gear and other parts, the engineer ought to understand that he is expected to undertake only common sense methods in getting the engine ready to move or ready to be hauled in. The writer once knew of an engineer who was pulling a light passenger train through a region where snow was heavy. In oiling round at one station he noticed a crack in the web of one of the eccentrics, became alarmed and at once proceeded to take down that side. He stalled in the first heavy snow drift struck after starting on one side, and blocked the division. After lying there for one day he got out of coal and conceived the idea of keeping the engine alive by burning corn. He entered into communication with neighboring farmers and soon had all the farmers of an Iowa county hauling loads of corn to make fuel for that snowbound locomotive. Before he was hauled out the engine had burned 1,650 bushels of corn at 60 cents a bushel.

That engineer felt very much aggrieved because his employers did not commend the enterprise he displayed in keeping his engine hot at an expense of nearly one thousand dollars. Most people were inclined to say that the man displayed more enterprise than judgment.

Moreover the eccentric was by the traveling engineer considered perfectly safe to run with the cracked web, the parts were ordered put together and the engine ran for years without any mishap.

Gold in the Sea.

Nearly all the minerals are contained in the sea in a state of solution. The sea water derives its saltness not only from common salt but from many other materials. *Harper's Weekly* says that the total volume of the European continent above the level of the sea is only one third as great as the block of salt produced by the evaporation of the oceans would be, could it be laid out as a solid.

The seas contain from 40 to 50 miligrams of gold per ton. This appears a very small amount, but there are a great many tons of water in the oceans, and the total amount of gold held in the water, if reduced to form a block and divided equally among the world's known population, would give every individual a provision of an ingot weighing approximately 80,000 lbs.

Hardening Twist Drills and Screw Taps.

A practical method of hardening twist drills and screw taps, whereby maximum strength is retained in the pieces treated, is as follows: The prepared drills or taps are held with their spiral or screwed parts submerged in molten lead (brought to red heat in iron or earthenware crucibles) till they too reach red heat; for pieces from 4 to 8 mm. in diameter this takes about one minute. The pieces are then withdrawn, and at once plunged into water. If the lead bath is at the correct temperature, no lead will cling to the taps or drills on removing them. After chilling, the latter are cleaned and tempered. A convenient method of tempering is to lay the drills and taps in lots of 10 or 12 on a sheet of iron mounted over a charcoal fire. The plate should be rocked during the process, in order that the pieces may be quite uniformly heated. On reaching a dark gold temper film, the goods are again water-quenched, and are then ready for use. The advantage of carrying out the first heating in lead instead of by direct firing is that the degree of heating is strictly limited, and it is impossible to burn the edges of the threads and drill grooves while waiting for the core to heat. Further, by the above process, only the working parts are hardened, and the heads of the taps or drills can be subsequently worked if necessary.

Boiling Point of Metals.

In a paper presented at a meeting of the Faraday Society, London, England, Mr. H. Greenwood gave the boiling point of various metals at atmospheric pressure, as follows:

	Degs. F.
Magnesium	2,050
Bismuth	2,550
Antimony	2,625
Lead	2,775
Copper	4,200
Silver	3,500
Tin	4,125
Aluminum	3,250
Chromium	4,000
Iron	4,450
Manganese	3,450

New Copper Alloy.

A copper alloy with the hardness of steel and great tensile strength is claimed by a French metallurgist. It is made by melting together 1 lb. each of chromium and aluminum and adding 22 lbs. of copper, 5 of nickel and 4 of zinc, with intervals of half an hour or an hour between the successive additions to the fused mixture. By varying the proportions of chromium and copper the alloy can be given a considerable range of properties, with adaptation to many uses.

To Prevent Railroads Using Waterways.

The National Waterways Commission, which has been investigating the relation of railways to waterways, in a report recommends to Congress that the power of the Interstate Commerce Commission be extended so as to include control over all water lines. It recommends further that all water lines be made subject to the same rules and regulations as are now imposed on railroad corporations in so far as they are applicable. The commission says that the time has come to take steps to prevent the elimination of water competition through railroad ownership.

This report, following on the heels of the Panama Canal bill now pending in the House, which would compel the divorcing of the railroad and steamship business, indicates that there is trouble ahead for some of the railroad lines, like the New York, New Haven & Hartford, that are interested in extensive water business. Probably, though, the railroad interests would be glad to accept the recommendations of the Waterway Commission if this would accomplish the defeat of the more radical House measure.

To Blacken Small Parts.

A dipping method for blackening small iron parts, in which two baths are used, is as follows, according to *Metalltechnic:* The first bath is made by dissolving 10 weight parts of copperas in twice the weight of water, also 15 parts of chloride of tin likewise, mixing the two, adding 20 weight parts of hydrochloric acid and diluting it all in about 400 parts of water. The articles are immersed in this bath for 10 seconds, rinsed in water and immediately placed for three minutes in the second bath, which is composed of 3¼ lbs. of "hypo" (sodium thiosulphate), 1-6 lb. of hydrochloric acid and 2 1-5 lbs. of water. It is produced by first dissolving the hypo in hot water, and the hydrochloric acid should not be added till the bath is to be used. There is a strong, visible action when it is poured in, and a yellow precipitate is formed which should be removed from the solution by filtering through muslin.

New Supply of Potash.

Enough potash to supply the United States probably for the next thirty years has been discovered by government scientists in Searles lake, San Bernardino county, Cal. The estimate of field men of the geological survey and the bureau of soils is that the deposit may amount to four million tons. The land on which the potash is located belongs to private individuals.

Air Brake Department

Diameter of Orifice Ins.	25	30	35	40	45	50	60	70	80	90	100	125
	AIR GAUGE PRESSURE IN POUNDS.											
1/32.......	.54	6.32	.71	.77	.843	.914	1.05	1.19	1.33	1.47	1.61	1.97
1/16.......	2.16	2.52	2.80	3.07	3.36	3.64	4.20	4.76	5.32	5.87	6.45	7.85
⅛.......	8.6	10.	11.2	12.27	13.4	14.5	16.8	19.	21.2	23.5	25.8	31.4
¼.......	34.5	40.	44.7	49.09	53.8	58.2	67.	76.	85.	94.	103.	125.
⅜.......	77.	90.	100.	110.4	121.	130.	151.	171.	.91.	211.	231.	282.
½.......	138.	161.	179.	196.3	215.	232.	268.	304.	340.	376.	412.	502.
⅝.......	216.	252.	280.	306.8	336.	364.	420.	476.	532.	587.	645.	785.

Table showing number of cubic feet of free escaping per minute from various sized openings.

Escape of Air Pressure.

The accompanying table shows the number of cubic feet of free air that will escape, per minute, from various sized circular openings from different air gauge pressures.

The table will be found of practical value in testing the efficiency of air pumps on locomotives, or for shop tests of repaired air pumps.

Brake Valve and Pipe Connections.

The view of the New York Air Brake Company's straight air brake valve of the L. T. equipment will require no detailed description. The reader will observe that in addition to the four positions which are used to admit air pressure from the main reservoir to the brake cylinders and from the brake cylinders to the atmosphere, there is a fifth position called the automatic release.

This position, as the name implies, is used to release the air pressure from the control reservoir when a release of the automatic brake is desired, and this feature supersedes the somewhat unsatisfactory lever release valve method.

When moving the valve handle to automatic release position a spring is compressed which returns the valve handle to the normal straight air release and running position as soon as the operators hand is removed, thus the handle cannot remain in automatic release position and prevent the application of the automatic brake.

While we cannot deal with this equipment in the lengthy instruction book or correspondence school method we wish tc call attention to the names of pipes of the L. T. brake while the subject of broken air pipes is mentioned.

The discharge pipe is the one that connects the air pump and the first main reservoir.

The equalizing pipe connects the first and second main reservoirs.

The reservoir pipe connects the main reservoir and the automatic brake valve.

The reservoir pipe has branches leading to the feed valve, reducing valve and control valve.

The feed valve pipe connects the feed valve to the automatic brake valve.

The brake pipe connects the automatic brake valve with the control and triple valves.

The reducing valve pipe connects the reducing valve to the straight air brake valve and also the signal system, when used.

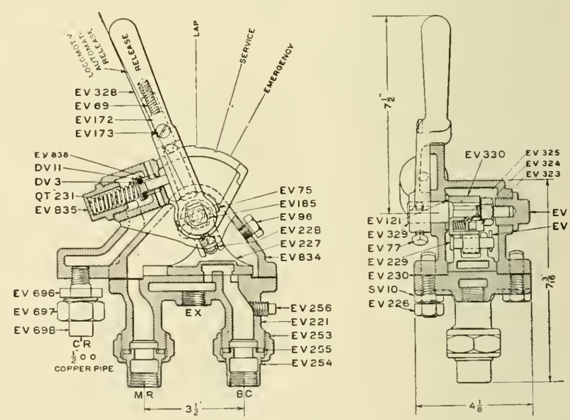
The main reservoir branch pipe leading to the control valve is generally referred to as the control valve supply pipe.

The governor pipe leads from the main reservoir to the maximum pump governor top.

The excess pressure governor pipe leads from the feed valve pipe to the excess pressure governor top.

The excess pressure operating pipe leads from the automatic brake valve to the excess pressure governor top.

The equalizing reservoir pipe connects the equalizing reservoir and the automatic brake valve.



N. Y. AIR BRAKE CO.'S STRAIGHT AIR BRAKE VALVE.

The straight air pipe leads from the straight air brake valve to the double check valve.

The brake cylinder pipe connects the control valve and the brake cylinders.

The control reservoir pipe leads from the control valve to the automatic and straight air brake valves.

The release pipe, or sometimes called the retain pipe, leads from the exhaust port of the control valve to the automatic brake valve.

The black hand gauge pipe leads from the equalizing reservoir connection to the large air gauge.

The red hand gauge pipe conducts main reservoir pressure to the large gauge.

The brake cylinder gauge pipe leads from the brake cylinder pipe to the red hand of the small gauge.

The brake pipe gauge pipe leads from the brake pipe below the brake valve cut-

out-cock to the black hand of the small air gauge.

The dead engine fixture piping is understood to connect the main reservoir and brake pipe through the non-return check valve.

Broken Air Pipes with L. T. Brake.

The large powerful locomotives of today have a tendency to develop pounds in their running gear, which often loosens reservoirs and this, as well as getting off the track in yards sometimes results in broken air pipes. On account of an inferior grade of pipe or due to poor workmanship, a broken air pipe is liable to occur at any time and what to do in order to get the train into a terminal with a broken air pipe on the engine, depends somewhat upon the circumstances and the time required to make the temporary repairs and in the following methods of temporary arrangements for bringing in an engine and train when an air pipe is broken and cannot be repaired, we will disregard any such arrangements as using a dead engine fixture or a signal line check valve for conveying air pressure from the main reservoir to the brake pipe or the employment of any freak connections in the gauge or governor pipes for this purpose, because if the flow of air to the brake pipe is not equal in volume to the capacity of the feed grooves of 8 or 10 triple valves, the method can hardly be recommended for a general practice.

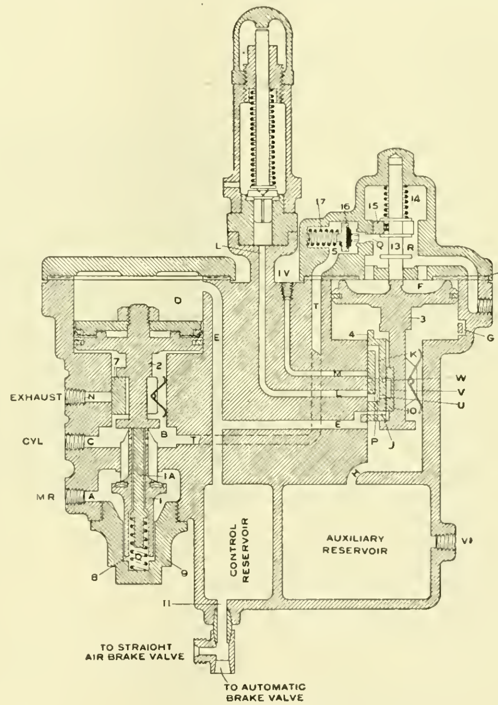
Assuming that the locomotive is equipped with the New York L. T. equipment we will begin with the pipes connecting with the control valve.

Should the retain pipe become broken off en route no repairs need be attempted, and while the holding feature of the automatic brake valve will be lost, the straight air brake valve can be used to compensate for the loss of the retain pipe.

If the control reservoir pipe was broken, the broken pipe leading to the control valve must be plugged to retain the automatic brake on the engine, and as the automatic brake cannot thereafter be released with the straight air brake valve, this fact should be borne in mind during an application of the brake. The control reservoir pressure maintaining feature in emergency would be lost.

If the brake pipe connection is broken off at the control valve it is only necessary to plug the brake pipe leak and the straight air brake valve can be used to apply the engine brake in conjunction with the train brakes when a stop is to be made.

It will be noted that the control valve would then admit air pressure to the brake cylinders if the automatic brake valve is placed in emergency position as the control reservoir will then receive air pressure from the brake valve through the control reservoir pipe.



AUTOMATIC CONTROL VALVE.

If the brake cylinder pipe is broken off at the control valve the stop cock in the supply pipe should also be closed to prevent a discharge and waste of main reservoir pressure when an automatic application is made.

The straight air brake can be used to operate the engine and tender brake.

If the supply pipe to the control valve is broken off, the escape of main reservoir air must be stopped either by closing the stop cock in the pipe or by plugging it and as in the previous instances the straight air brake can be used on the engine and tender.

If the automatic control valve in question has a quick action cylinder cap, there will be an exhaust of air from the broken pipe leading to the control valve if an emergency application or a brake pipe reduction passing the point of equalization is made. The air pressure in this case would be from the brake pipe past the emergency slide valve of the quick action cap and under certain conditions this feature could be employed to provide a brake for the engine and tender alone, but so long as the straight air brake is operative this is unnecessary.

If the straight air pipe is broken off no temporary repairs are necessary, as only the straight air brake will be disabled.

If the reducing valve pipe is broken, the adjusting nut of the single pressure controller or reducing valve need only be unscrewed to prevent the escape of main reservoir pressure.

If the branch pipe between the straight air brake valve and the control reservoir pipe is broken the break would be plugged toward the control valve and as in the case of the broken control reservoir pipe, the automatic brake could not be released with the straight air brake valve.

As previously stated, we have no desire to suggest anything questionable or impracticable in these methods of overcoming engine failures due to broken air pipes, but if the brake pipe is broken between the brake valve branch and the rear of the engine, the signal pipe can sometimes be used by uniting the hose on the pilot and making a signal pipe and brake pipe connection at the rear of the engine or rear of tender, or if the brake valve branch of the brake pipe is broken a connection can sometimes be made between the brake pipe and brake cylinder hose at the rear of the engine and if this can be done the brake cylinders on the engine can be cut out and the air pressure admitted to and exhausted from the brake pipe by means of the straight air brake valve. The single pressure controller or reducing valve can be adjusted to give any brake pipe pressure desired

and the safety valve can be set accordingly. In this manner a train can be taken into a terminal with the brake pipe charged and the same method might be used in the event of a broken reservoir pipe or a disabled automatic brake valve.

If any of the gauge pipes are broken they need only be plugged to prevent the escape of air and if the equalizing reservoir pipe was broken both the broken pipe and the brake pipe exhaust port of the automatic brake valve would be plugged and the brake valve used by carefully moving to emergency position for applying the brake and moving slowly back to lap position when the brake pipe reduction is completed.

If the feed valve pipe was broken, the method of temporarily overcoming the break would depend somewhat upon the place of breakage, but at any point, both ends of the broken pipe would be plugged and the brake valve used in release instead of running position. If the connection to the pump governor was in the section of the broken pipe next to the brake valve, a position half way between release and running position of the brake valve could be used which would maintain air pressure in the spring box above the diaphragms of the excess pressure governor top as well as in the brake pipe.

If the governor connection is between the feed valve and the break in the pipe, full release position would be used to maintain pressure in the brake pipe and in either case it would likely be desirable to set the maximum governor top to the brake pipe pressure to be used.

If the adjusting screw or the spring box of the feed valve was unscrewed to stop the flow of air from the broken pipe and if the governor connection was between the feed valve and the break, there would be no air pressure in the spring chamber of the excess pressure governor top and the pump could not be started until the lower or operating pipe was also plugged.

If the excess pressure operating pipe of the governor is broken, the leak can be plugged and the maximum governor top will control the pump, but if the excess pressure governor pipe is broken, both it and the operating pipes must be plugged or have blind gaskets inserted in their union connections, otherwise main reservoir pressure under the diaphragms would unseat them and hold the steam valve closed in any of the first three positions of the brake valve.

If the pipe leading to the maximum governor head was broken off the excess pressure top would control the pump in the ordinary manner, but if the brake valve handle was to remain in service or lap position for a considerable length of time it might be advisable to throttle the pump to prevent a main reservoir pressure equal to the boiler pressure.

In breaking the pipe connecting the dead engine, fixture air will only flow from one end of the broken pipe, the cutout cock being closed, and this leak can be plugged and reported to be repaired when the engine arrives at the round house.

Passenger Train Braking.

In past issues attention has been directed to the importance of the time element during the manipulation of the brake valve in freight service, both as to application and release position and at the present time passenger car brakes, with particular reference to the "L. N." and "P. C." type, will be considered.

When handling trains equipped with these types of brakes, the time and place of the movement of the brake valve handle must be as carefully considered as in the operation of freight car brakes, in fact, due to higher speeds and comparatively shorter stops, the time element is in some respects of more importance.

With the graduated release type of brakes, where the pressure can be graduated into, or out of, the brake cylinders at will, there are two ways in which one may become proficient in their manipulation, one is by actual practice, which is usually costly to some one, or by handling and observing the action of these brakes on a test rack or in an air brake instruction car. When handling the brakes or watching a demonstration, particular attention should be given to the time required to obtain differentials in pressure, to the time required to obtain certain brake cylinder pressures, the time required to exhaust a certain number of pounds pressure from the cylinders and to the time in which the reservoirs and chambers supplied from the brake pipe can be charged to, or beyond the adjustment of the brake pipe pressure controller.

To carefully note this elapsed time will give an accurate conception of the manner in which the desired results are obtained in actual practice and will leave a lasting impression upon the mind of the observer, and be of inestimable value if called upon to handle trains of modern brake equipment.

As with freight brakes, no definite recommendations are formulated to cover all conditions of service and the following will contain only such advices as are considered to be a good general practice.

As practically all modern locomotives are equipped with the E. T. or L. T. brake equipments it may be well to first note the recommendations for the use of these brakes in passenger service.

As to the operation of the No. 6 E. T. brake, in making the first release of a two-application stop, the brake valve handle should be moved to release position and then quickly back to running position, where it should be allowed to remain for an instant, first to permit the pressure in the equalizing reservoir and the brake pipe to equalize, second, to release part of the engine and tender brake cylinder pressure, then move to service stop position.

The time the handle is in release position is momentary, but the time the handle then remains in running position must be governed by the conditions existing in each particular case, with particular attention to length of time, kind of reduction made and time available.

Service stops with passenger trains of less than 9 or 10 cars should be made with two applications of the brake, and the latter application released before coming to a stop, provided that grade of track will permit, and it is generally conceded that with 10 or more cars the brakes should be held applied until the train has stopped.

A smooth and accurate two-application stop is made by the first application being heavy enough to bring the speed down to about 15 miles per hour at a convenient distance from the stopping point to permit a release by moving to release and running position as required.

On passenger trains of more than 9 or 10 cars the release of the first application should be made before the speed has reduced below 15 miles per hour, the brake valve handle being placed in release position for a period of time that varies with the number of cars in the train, type of brake equipments and the air pump and main reservoir capacity, and the second application not to be released until after the train has stopped.

The object sought in releasing the brake before the final stop with short trains is to have the brakes practically released before the train and engine stops, which will prevent the disagreeable lurch that is experienced when trains are stopped with the coupler springs partially compressed and the truck springs a trifle distorted. The release after a one-application stop is made in the same manner as a final release of the two-application stop.

Now, the above recommendations were made with particular reference to the locomotive brake in passenger service handling the high-speed brake and the advent of the L. N. and P. C. type of car brakes do not render those recommendations valueless, but the successful operation of these latter type of brakes is enhanced by large air pump capacity which is prevalent on modern locomotives. Ample main res-

ervoir capacity is also provided, therefore the use of such locomotives compels a more careful observance of the use of several positions of the brake valve.

With the equipments mentioned both shorter and smoother stops can be made than was possible with the high-speed brake, thus the train can be run in closer to the station before starting the application and the ability to graduate pressure into, or out of, the brake cylinders at any time during a service stop, makes two applications unnecessary after some practice in stopping such trains is obtained.

It will be understood that during a transition period, supplementary reservoirs of the L. N. equipment are sometimes cut out or some control valves of the P. C. brake may be cut into direct release and a quick recharge feature of the L. triple valve will recharge an auxiliary reservoir as fast as brake pipe pressure can be raised while a feature of the No. 3-E control valve is to prevent the auxiliaries from absorbing brake pipe pressure until very nearly the maximum is reached during an ordinary release, therefore it becomes apparent that air brake men are careful in suggesting a method of brake operation that will be the most successful under the varying conditions.

While some of the so-called difficulties encountered in the use of these equipments is imaginary, some are due to defective equipment, but it is safe to say that about three-fifths of the actual troubles are due to an incorrect use of release position of the brake valve.

The freedom from variations in the maintainance of a predetermined brake pipe pressure becomes absolutely essential and an overcharge in the large reservoirs of these car equipments means carrying the valve handle in release position or a stop to bleed off brakes if the brake pipe leakage is sufficient to apply them.

The late types of passenger car brakes contain features that prevent the depletion of pressures in the systems during service operations and are intended as a factor of safety as the train will be stopped before any material lowering of the pressure can occur, therefore there is an absolute necessity of an intelligent use of the brake valve, especially full release position.

A delay of one hour to a first-class train due to bleeding off of the brakes of an L. N. equipment, is a forcible illustration of the grief that may be the result of a misconception of the action of the particular type of brake in use.

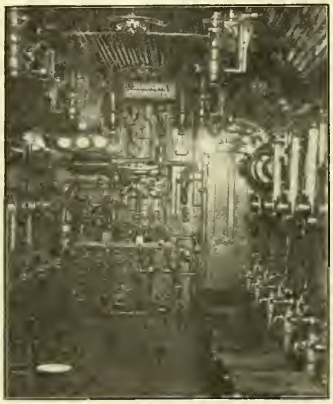
Another illustration is a delay of over an hour on account of brakes failing to release. The cause of this "bleeding" was due to the fact that the train was brought in with a 90-lb. brake pipe pressure and the feed valve on the locomotive coupling on was set at 70 lbs.

In view of the difficulties that may result from an overcharged brake pipe and because of some methods of application that are conducive to an overcharge we would print three very brief recommendations in handling a brake valve when a modern locomotive is coupled to a train of modern passenger car equipment. They are very easy to remember and just as easily put in practice.

Avoid staying in full release position over one second.

Avoid making brake pipe reductions less than 10 or 12 lbs.

In case the engine fails for steam, use full release position.



AIR BRAKE INSTRUCTION CAR NO. 2, B. & O. R. R.

These rules are applicable to general conditions and a minimum reduction of 10 lbs. is based upon the frequent cause of stuck brakes on the rear cars of a train due to too light a brake pipe reduction before the movement to release and prompt return to running position. It is obvious that the less differential between main reservoir and brake pipe pressure the more difficult it is to accomplish a complete release, and a 10-lb. reduction tends to cause a prompt opening of the feed valve to maintain the brake pipe pressure.

When a slow down is desired that might be made with less than a 10-lb. reduction, it is better not to run the risk of sticking some of the brakes, but to make a 10 or 12-lb. reduction and release immediately. In case this might stop the train, it is permissible to use steam while the application is made.

In making stops from speeds of 40 miles per hour or more reductions of 20 or 25 lbs. should be made, and if it is found that the first application will stop the train short of the desired point, a two-application stop can be made with old-style triple valves or the release can be graduated if the L. N. or P. C. brakes are in use.

A gradual building up of brake cylinder pressure during a stop must be avoided, as the ideal stop is made by commencing it with a high-cylinder pressure when the speed is high, and completing the stop with a comparatively low cylinder pressure. The gradual building up is brought about by a number of light consecutive reductions in brake pipe pressure, and the high cylinder pressure at the beginning of the stop is secured with the heavy initial reduction.

In reference to the third rule, should it become necessary to carry the valve handle in release position between stations, an overcharge can be exhausted by means of the brake valve when the train is standing at the station, but it may require two or possibly three heavy 20 to 25-lb applications, and the releases made in the manner outlined will lower the supplementary pressure below the adjustment of the feed valve, but during this manipulation the brake valve should remain in lap position for a few seconds after the brake pipe exhaust ceases, to permit an equalization of pressure throughout the entire train, which is of real importance both in fast freight as well as in passenger service.

In bleeding off brakes of the P. C. equipment the bleeder cocks in both the service and emergency reservoirs should be opened.

To bleed off a brake of the L. N. equipment the bleeder cocks of both the auxiliary and supplementary reservoirs should be opened, however, some care must be exercised in the bleeding, as exhausting all the pressure from one car is liable to complicate matters in causing a brake pipe reduction on other cars in the train, but ordinarily the bleeder cock in the supplementary reservoir can be held open for a space of 10 or 15 seconds which will not release the brake, but will lower the supplementary pressure sufficiently to enable the engineer to accomplish the release.

In the manipulation of the brake valve it should always be understood that the rise and fall of pressure during application and release of brakes depends more upon the length of the train than the position of the brake valve handle, and when using brakes of modern design, the brake pipe feed valve should be in a condition to regulate the pressure without permitting any noticeable variation and the air gauge should be accurate in registering this pressure.

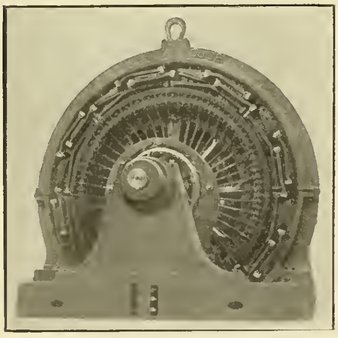
Electrical Department

A 7,500 Kw. Commutating-Pole Rotary.

The illustration shows a side-view of the 7,500 kw. Rotary, built by the Westinghouse Electric & Manufacturing Company, which is installed in the 96th Street Sub-station of the Interborough Rapid Transit Company. A most remarkable feature is that the machine occupies but a trifle more floor space than was occupied by each of the old 1,500 kw. machines, which were standard with the Interborough Company a few years ago.

Although guaranteed to take care of load swings, the rotary has successfully handled swings one-third greater than its rating, or 10,000 kw.

Real estate in New York, and in other cities is, as every one knows, very expensive, so it is imperative that the metropolitan public service companies use every square foot of sub-station floor area most effectively.



7,500 KW. INTERPOLE BATTERY.

Think what it means to the railway company to be able to increase the capacity of the sub-station by replacing an older type of rotary converter by one similar to our illustration, which is capable of doing several times the work of the older machine and still occupying very little extra space. For our readers to comprehend the large power of this machine the 7,500 kw. is equivalent to 10,050 h. p., and with swings of 10,000 kw. the rotary is delivering 13,400 h. p. of electrical energy for the running of electric trains.

Control for Railway Motors.

Having described in our previous articles the various parts of a railway motor and the methods of mounting on the truck, we now come to consider the various forms of control apparatus used to start up and regulate the speed of the cars. Before describing the different methods we will point out and explain the characteristics of a railway motor.

Railway motors are of the series type, i. e., the field coils and the armature are connected together, so that the same current which flows through the armature flows through the fields, as shown by the schematic diagram, Fig. 2. To understand the working of the motor it is necessary to know of the "back or counter electromotive force" which is present in all motors. While the motor is running there is a voltage generated in the armature coils due to the conductors passing by the face of the poles. This voltage is the "back or counter electromotive force," as it is opposed to the voltage from the source of power. It is this back electromotive force that permits the resistance in series with the motor to be cut out as the motor increases in speed. When the motor is at rest there is no choking effect and the internal resistance of the motor is all that opposes the flow of current, so that if the full voltage of the power supply was connected to the motor without any external resistance a very large amount of current would flow through the motor, causing the windings to overheat and damaging the motor. By inserting resistance, however, of such value that the current will not exceed a certain predetermined value, the motor will start slowly and begin at once to generate this "counter electromotive force," choking down the current. The resistance can be cut out step by step until no more is in circuit, at which speed the "counter electromotive force" is of such value that the current flowing through the motor does not exceed the safe amount. The motor will continue to speed up, the current taken from the supply, decreasing with increasing speed and will reach a balance speed when the current is such that the product of this current and the field strength gives the pull or turning power necessary to do the work required.

As the field and armature are in series with the same current value in each, the strength of the field varies with the load as more current is required with increase of load, which affects both the torque of the motor and the speed. The torque or turning power of the motor is the pull available at one foot radius from the center of the armature shaft and depends on the product of the field strength and current flowing through the armature. The speed decreases with increase of current as the field strength is increased and a lesser number of revolutions are required to give the counter electromotive force such that the difference between the impressed voltage and this counter electromotive force will give the current necessary to do the work.

It is the methods and apparatus used for cutting of the resistance in and out

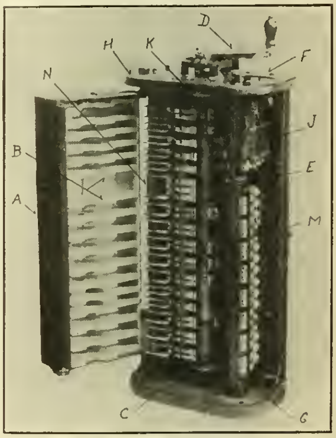


FIG. 1.—LATEST TYPE OF K CONTROLLER.

of the circuit that we are interested in and how the engineer of the locomotive or the motorman of the street car starts up and accelerates the train or car.

In the earliest electric locomotives built by Thos. A. Edison in 1880-2, the speed was controlled by regulating the slipping of a clutch, the motor running at constant speed. In the case of the locomotive called "The Judge," 1883, a rheostat or "throttle," as it was called, was used. It consisted of a few contacts, on a base, connected together by iron wire. By means of another lever a sliding contact could be connected to any segment, and suitable resistance was thus put in series with the motor so that the speed desired was obtained. The locomotive was

reversed by changing the brushes on the commutator, i. e., four brushes were provided, but only two were in contact at one time. Changing the brushes would allow the current to flow in the opposite direction in the armature and thus change direction of rotation. Only one set of brushes is used today on railway motors, and the proper connections for changing the direction of flow of current in the armature are made in the control apparatus. Wires, known as motor leads, which connect to the brushes and the fields are run from the motor to the control apparatus.

Frank J. Sprague, who, in 1886, made tests with a car on the 34th Street branch of the Manhattan Elevated, used a control which was entirely different from any used before. The motors were wound, with two sets of field windings, one in series with the armature and one in shunt. At the start, a resistance was placed in series with the armature and increased speed was obtained by cutting out the resistance step by step, and then inserting it step by step in the shunt field. Two motors were used running in parallel, and this was the first time that two motors had been simultaneously controlled.

In 1887, Stephen D. Field regulated the speed of his test locomotive, which operated over the same tracks as Sprague's test car, by means of a water rheostat. The rheostat consisted of a tank partially filled with water, to which was added a very small quantity of acid. Two plates, one connected to the power and the other to the motor, were placed in the water. Current would flow, the amount depending on the depth the plates were dipped into the water. This method is used on some of the foreign electric locomotives at the present time.

By the end of 1890, Sprague, the Thomson-Houston Company and the Westinghouse Electric Company, had built some very successful motors. Each had a slightly different method of controlling the speed of the car from start to maximum.

The Sprague system depended mostly on change in field strength for change in speed. We know that when the field of a motor is weakened, the speed increases; also that a resistance placed in series with the motor cuts down the current and the voltage at the terminals and hence decreases the speed. Sprague's motors were wound so that several different field strengths could be obtained. In starting, a small resistance was connected in series, to allow the motor to start up slowly. This resistance was cut out in one step and increase speed was obtained by cutting out sections of the field coils which would weaken the fields.

The Thomson-Houston system used mostly the change in resistance which was cut out step by step. After all the resistance was cut out a slight increase of speed could be obtained by cutting out a few turns of the field coils.

The Westinghouse system was a compromise of the above two systems.

It was two or three years after this that the General Electric Company brought out the Type K control, which is the type used today in almost every street car throughout the country. This K controller was of the series parallel type. By series parallel we mean that in starting up, the motors are connected in series with an external resistance. This resistance is cut out in three or four steps. To increase the speed the motors are then connected in parallel with the same resistance in the circuit which is cut out again step by step. The speed of the car will be double that of when the motors are in series.

Many improvements have been made in the K controller, but the general shape, arrangement of contacts, etc.,

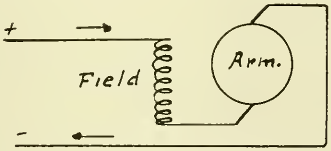


FIG. 2.—CONNECTIONS FOR SERIES MOTOR.

are the same, and so we will describe one of the latest design shown by Fig. 1 known as the K 35 controller. This view shows the inside of the controller, with the complete arc deflector (A) opened and swung back. In normal position for operation of the controller this are deflector is closed, so that each division plate or arc shield (B) will occupy the space between the contact fingers (C). The whole front of the controller box is then covered over by a wooden cover lined with asbestos. In this, the latest type of K controllers, the operating handle (D) is connected directly to the shaft, to which is fastened the main cylinder (E), dispensing with gears as on some of the older styles, so that the controller operates easily. The reverser handle (F) which operates the reverser drum (G) is interlocked with the power operating handle (D), so that the latter can not be moved unless the reverse handle is fully set in either forward or reverse position; also in case the power handle is not in the "off" position the reverse handle can not be moved. Directly below the controller cap (H) is the star wheel (K) which enables the operator to place the handle in the correct position for each notch. The method of fastening the cylinder (E) to the shaft is far superior to earlier types. The controller shaft is of hexagonal section, and is wrapped with heavy insulation, over which the cylinder castings fit. These castings are firmly secured by set screw bearings on steel keys. This method prevents the cylinder from shifting around the shaft and facilitates removal or replacement.

The terminal board to which the motor leads connect in other K controllers is done away with and the cables are attached directly to the finger bases. The terminals are of the clamp type, so that no soldering is required and connections can be securely and quickly made. Cut-out switches (J) are provided, so that a damaged motor can be cut out of circuit.

One, if not the most, important part of a controller is the blowout which is to prevent serious flashing in the controller resulting in a short circuit which burns the controller. The method used in the K 35 controller is to provide individual magnetic blowouts for each main finger (C) which insures the extinction of the arc under most severe operating conditions.

As the power handle (D) is turned around the fingers (C) make contact with the contact pieces or segments (M) so that the electric power can flow from the trolley through the contacts and fingers to the motors. Thus the main currents are handled directly in the controller and in passing from one point to the next arcing occurs when the fingers break contact with the segments (M), due to the electric current jumping across. This arcing may be excessive, and means must be provided to blow out the arc, thus preventing burning of the fingers (C) and segments (M), and preventing the arc jumping to another finger resulting in a short circuit.

Referring to Fig. 1, when the arc deflector (A) is closed into place there is an arc shield on top and bottom of each finger or group of fingers. For each finger or group there is a blowout coil (N). These blowout coils are simply turns of wire, through which flows the motor current, wound around steel cores, which are fastened to the finger basis. Steel plates are embedded in each arc shield (B), which distributes the magnetic flux through the arc shutes (the space between the arc shields) parallel to the shaft and at right angles to the arcs formed. The scheme used in the older types of K controllers is one long blowout coil for all the fingers, which means a much weaker field for disrupting the arc with not nearly as good operation.

Pacific Type of Locomotive for the Frisco Lines

The enterprising experiments that are being conducted by the American Locomotive Company recently have undoubtedly resulted in an increase of tractive power in certain classes of locomotives, more especially in the Pacific type, and in proof of this an excellent illustration is herewith given showing that a theoretical tractive power, 1,000 pounds greater, at 50 miles per hour than the average at that speed for other locomotives of the same type of approximately the same weight is a feature worthy of particular notice. This, combined with an undoubtedly ample boiler capacity to deliver its calculated cylinder power at that speed makes the design of the Pacific type locomotive built by the American Locomotive Company for the Frisco Lines, one deserving of careful study. This locomotive is illustrated herewith.

A comparison between the tractive powers at various speeds from starting up to 50 miles per hour of the Frisco locomotive and the average for 5 other representative Pacific type locomotives of recent construction of approximately the same weight is given in the annexed table.

Assuming that the locomotive will deliver a tractive power of 14,660 pounds at 50 miles per hour, as shown in the annexed table; this would mean 1,950 indicated horse power. At a rate of steam consumption of 21.6 pounds per 1 h. p. per hour, a conservative average figure for a superheated engine, even when not worked to its capacity, and including steam used in cylinders and air pumps and losses through safety valves this would mean a water evaporation of 42,206 pounds or 11.4 pounds per sq. ft. of heating surface per hour. Except with a poor grade of coal, the boiler should be able to maintain this rate of evaporation at 175 pounds boiler pressure, the working pressure employed, without difficulty.

Assuming a fuel consumption of 3¼ pounds per indicated horse power per hour, the rate of combustion with the 50.9 sq. ft. of grate area required to maintain the above capacity would be only 122 pounds per sq. ft. of grate area per hour.

COMPARATIVE TABLE SHOWING PERCENTAGE OF GAIN.

Speed, M. P. H.	Theoretical tractive power. (Per A. L. Co.'s Formulæ.) Frisco.	Average of 5 Pacifics of approximately same weight as the Frisco.	Difference in tractive power in favor of Frisco Pacific. Pounds.	Per Cent.
Starting	40,800	34,140	6,660	19.5
30	24,760	22,670	2,090	9.2
35	21,210	19,540	1,660	8.6
40	18,560	17,110	1,450	8.4
45	16,440	15,200	1,240	8.1
50	14,660	13,650	1,010	7.4

The following are the principal dimensions of this type of locomotive:

Cylinder—Type, simple piston valve; diameter, 26 ins.; stroke, 28 ins.

Track gauge, 4 ft. 8½ ins.; tractive power, 40,770 lbs.

Wheel—Base, driving; 12 ft. 6 ins.; rigid, 12 ft. 6 ins.; total, 33 ft. 1 in.; wheel base, total, engine and tender, 64 ft. 9 ins.

Weight—In working order, 260,500 lbs.; on drivers, 158,000 lbs.; in working order, engine and tender, 421,700 lbs.

Heating surface—Tubes, 5⅜, 896.5 sq. ft.; 2 ins., 2,575 sq. ft.; firebox, 204.28 sq. ft.; total, 3,675.8 sq. ft.; S. H. surface, 758.6 sq. ft.

Grate—Area, 50.9 sq. ft.

Axles—Driving journals, main 10½ ins. x 13½ ins.; others, 10½ ins. x 13½ ins.; engine truck journals, diameter, 6½ ins.; length, 12 ins.; trailing truck journals, diameter, 8½ ins.; length, 14 ins.; tender truck journals, diameter, 5½ ins.; length, 10 ins.

Boiler—Type, extended wagon top; O. D. first ring, 74 ins.; working pressure, 175 lbs.; fuel, bitum. coal.

Firebox—Type, wide; length, 108 ins.; width, 68½ ins.; thickness of crown, ⅜ in.; tube, ½ in.; sides, ⅜ ins.; back, ⅜ in.; water space, front, 4½ ins.; sides, 4½ ins.; back, 4½ ins.

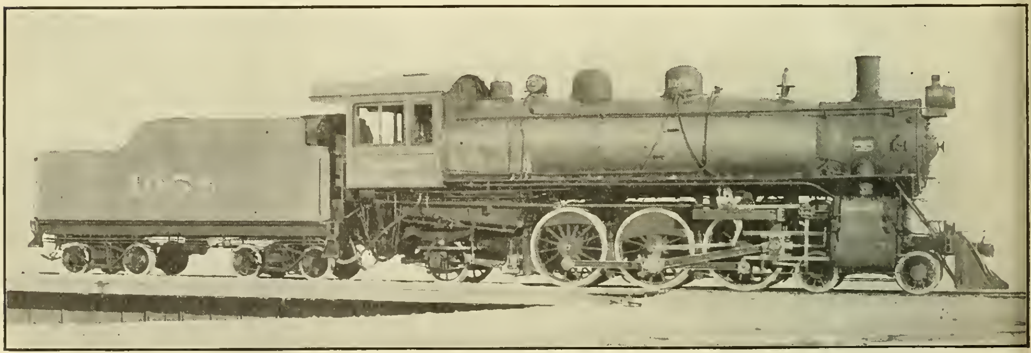
Crown staying—Radial; tubes, material, seamless steel No. 247; diameter, 2 ins.; length, 20 ft.; gauge, No. 11 B. W. G.

Boxes—Driving, main and others, cast steel.

Brake—Driver, New York; tender, New York; air signal, New York; pump, No. 6 Duplex; reservoir, 1-20½ ins. x 42 ins., 1-20½ ins., x 60 ins., 1-24½ ins., x 60 ins.

Engine truck—Four-wheel swing motion 3 point suspension hanger.

Trailing truck—Radial with outside bearing.



PACIFIC TYPE OF LOCOMOTIVE FOR THE FRISCO LINES.

Geo. A. Hancock, General Superintendent of Motive Power. American Locomotive Company, Builders.

Exhaust pipe—Single; nozzles, 5¾ ins., 6 ins., 6¼ ins.

Grate—Style, rocking.

Piston rod—Diameter, 4¼ ins.; piston packing, Gun iron ring.

Smokestack—Diameter, 18 ins.; top above rail, 16 ft.

Tender—Frame, Ry. Co.'s center sills, 13 ins. No. 55 channel; side sills, 10 ins. No. 30 channel.

Tank—Style, U-shape sloping side and back coal space; capacity, 8,100 gals.; fuel, 14 tons.

Valves—Type, piston; travel, 6 ins.; steam lap, 1 in.; expansion lap, clearance, line and line.

Setting—3/16 in. lead, not less than 85 per cent. cutoff.

Wheels—Driving diameter, outside tire, 69 ins.; centers diameter, 62 ins,; engine truck, diameter, 33 ins.; kind, spoke; trailing truck, diameter, 42 ins.; kind, spoke center; tender truck, diameter, 33 ins.

Thirty-two flues, 5⅜ ins. diameter, No. 9 B. W. G. Seamless Steel.

Items of Personal Interest

Mr. Samuel Ashford has been appointed division foreman of the Missouri Pacific at Wichita, Kan.

Mr. C. Houston has been appointed master mechanic of the Nacozani Railroad, with office at Nacozani, Mex.

Mr. Frank W. Taylor has been appointed master mechanic of the Minnesota & Iowa divisions of the Illinois Central, with headquarters at Waterloo, Iowa.

Mr. J. C. Fosdick has been appointed road foreman of engines of the Chicago & Northwestern on the West Iowa division, with headquarters at Boone, Iowa.

Mr. Geo. Langton has been appointed master mechanic of the Texas & Pacific at Marshall, Tex., succeeding Mr. O. A. Clarke.

Mr. F. E. Balda has been appointed master mechanic of the New York, New Haven & Hartford, at East Hartford, Conn., succeeding Mr. J. M. Collins.

Mr. J. D. Wells has been appointed district master mechanic of the Eastern division of the Canadian Pacific at Farnham, succeeding Mr. A. W. Horsey.

Mr. John A. Bell has been appointed master mechanic of the Indiana division of the Illinois Central, with headquarters at Mattoon, Ill.

Mr. W. H. Graves has been appointed roundhouse foreman of the Rock Island at Pratt, Kan., and Mr. E. Robertson has been appointed road foreman of equipment at the same place.

Mr. G. S. Wilber has been appointed master mechanic of the Burlington at St. Joseph, Mo., and Mr. H. S. Mored has been appointed to fill a similar position at Ottumwa, Iowa.

Mr. T. M. Vickers, formerly master mechanic of the Missouri Pacific at Coffeyville, Kan., has been appointed master mechanic of the San Pedro, Los Angeles & Salt Lake, with office at Milford, Utah.

Mr. T. McHattie has been appointed master mechanic of the Eastern division of the Grand Trunk, with office at Montreal, in place of Mr. J. Duguid, assigned to other duties.

Mr. J. A. Haley has been appointed master mechanic of the Bellingham Bay & British Columbia Railroad at Bellingham, Wash., succeeding Mr. M. Dailey, resigned.

Mr. W. L. Robinson, formerly special inspector of the mechanical department of the Baltimore & Ohio, has been promoted to road foreman of engines of the Baltimore division, with office at Baltimore, Md.

Mr. H. H. Honaker, master mechanic on the Frisco System, has been transferred from Birmingham, Ala., to Fort Scott, Kan., where he will have charge of the mechanical work for the northern district of the road.

Mr. J. E. Fitzsimons, formerly road foreman of engines of the Central Vermont at St. Albans, Vt., has been appointed acting superintendent of motive power and car department, with office at St. Albans, in place of Mr. T. McHattie, resigned.

Mr. V. C. Randolph, formerly supervisor of locomotive operation of the Erie at Salamanca, N. Y., has been appointed master mechanic of the Rochester division of the Erie, the New York, Susquehannah & Western and the New Jersey & New York, with office at Avon, N. Y.

Mr. W. R. Ladd, formerly assistant superintendent of the Oregon-Washington, has been appointed master mechanic of the shops at Albina, Ore. Mr. I. H. Watson has been appointed division foreman at Seattle, Wash., and Mr. E. Thomas has been appointed division foreman at La Grande, Ore., succeeding Mr. Watson.

Mr. E. W. Rogers, general foreman boilermaker of the Rogers Works of the American Locomotive Co., at Paterson, N. J., has been transferred to the Schenectady plant of the same company, in place of Mr. F. G. Bird, formerly general foreman, who is now general foreman of all of the plants of the American Locomotive Company.

The following changes have been made on the Rock Island: W. J. Tollerton, J. B. Kilpatrick, G. W. Mullinix, and C. M. Taylor, appointed mechanical superintendents for the districts in which they have been assistant superintendents of motive power, that title and that of assistant superintendents of motive power being abolished.

Mr. Joseph McCabe, formerly road foreman of engines on the New York, New Haven & Hartford, has been appointed master mechanic of the western division of the same road, in place of Mr. J. N. Mowery, resigned, and Mr. Charles H. Reid, formerly road foreman of engines, of the Shore line division, has been appointed general road foreman of engines, in place of Mr. McCabe, promoted.

Mr. George Sherwood Hodgins, who was formerly editor of Railway and Locomotive Engineering and is now a frequent contributor to our columns, has been engaged by the Commissioners of the National Transcontinental Railway of Canada to make a special report concerning the shops and equipment of the various round-houses, terminal shops, etc., now built or being constructed on that line. Mr. Hodgins will be some months on this work, in the land of the Maple Leaf.

Mr. P. E. Crowley has been appointed general manager of the New York Central & Hudson River, with headquarters at New York; Mr. A. T. Hardin, vice-president; Mr. J. J. Bernet, assistant vice-president, with office at Chicago, Ill.; Mr. H. L. Ingersoll, assistant general manager at New York; Mr. W. J. Fripp, assistant general manager at Albany, N. Y., and Mr. A. H. Smith, vice-president, in charge of operation, maintenance and construction. All appointments were effective last month.

At the annual meeting of the stockholders of the Joseph Dixon Crucible Company, held at the company's main office in Jersey City, N. J., Monday, April 15, the retiring Board of Directors, consisting of Geo. T. Smith, William Murray, Edward L. Young, William H. Corbin, Geo. E. Long, William G. Bumsted, and Harry Dailey, was unanimously re-elected.

Officers elected for the ensuing year are as follows: President, Geo. T. Smith; vice-president, W. H. Corbin; treasurer, Geo. E. Long; secretary, Harry Dailey; assistant treasurer and assistant secretary, J. H. Schermerhorn.

Mr. W. D. Cantillon, general manager of the Chicago & Northwestern, announces the following appointments: Mr. S. G. Strickland, assistant general manager of the lines east of the Missouri river, in place of Mr. W. E. Morse, resigned. Mr. W. J. Towne, general superintendent in the same district, except Minnesota and Dakota divisions. Mr. Geo. C. Boomer, assistant superintendent, northern Wisconsin division. Mr. W. B. Linsley, resident superintendent, Escanaba, Mich. In addition to his other duties Mr. Linslay will have charge of the company's tie-treating plant. Mr. W. H. Dolan, assistant superintendent, Lake Shore division. Mr. J. W. Doyle, superintendent of the Minnesota division. Mr. H. E. Dickinson, superintendent of the Dakota division, and Mr. G. B. Vilas, assistant general superintendent of lines east of Missouri river. These appointments all took effect last month.

OBITUARY.

Charles M. Hays.

Among the passengers who lost their lives in the sinking of the steamship *Titanic* was Charles Melville Hays, president of the Grand Trunk Railway, who labored heroically to get the women and children into the life boats and then courageously went down with the ship. Mr. Hays entered railway service as a clerk in 1873, and rose gradually to higher positions through the force of doing his work in a way that was thoroughly satisfactory to his immediate superiors. In 1884 he became secretary to the general manager of the Missouri Pacific, and was celebrated for the wide grasp of the business which he overtook. The writer made his acquaintance at this time, and found him the best informed chief clerk he had ever known, always ready to give information and thoroughly informed concerning every detail of railroad business. That unusually strong grasp of details combined with clear, far-seeing perception recommended him upward step by step in the councils of those needing high-class help. After filling a variety of important positions, Mr. Hays was in 1901 elected general manager of the Grand Trunk Railway, a position he relinquished for about a year to become president of the Southern Pacific. Then he went back to the Grand Trunk, where he remained with the very highest honors until his untimely end came. Mrs. Hays and daughter were on board the *Titanic*, and were saved, the devoted husband and father having struggled successfully to place them in one of the boats, after which he submitted gallantly to his fate. Mr. Hays' strong characteristic was helpfulness to others, a trait nobly manifested in the end. Much sympathy is being expressed to the bereaved family.

CHARLES MELVILLE HAYS.

Colonel John Jacob Astor.

Colonel John Jacob Astor, who was largely interested in railway property, lost his life on the unfortunate steamer *Titanic* after having given heroic help in the saving of others. John Jacob Astor was born at Rhinebeck, N. Y., in 1864 and educated at St. Paul's School Concord at Harvard. He was the kind of person whose misfortune it was to be born rich. His great national activities were stunted for want of the inducements that would have led to their development. When he left college John Jacob became ambitious to learn and practice locomotive engine running. With that idea in his mind he studied Sinclair's Locomotive Engine Running and actually ran engines on a railroad when he was a director. Then he turned his attention to military matters and Governor Morton appointed him on his staff with the rank of Colonel. On the breaking out of the war with Spain he gave a complete and fully equipped battery of artillery to the United States Government. He served in Southern camps and in Cuba, and was detailed by Major-Gen. Shafter to deliver official terms of capitulation to the Secretary of War. Owing to strong mechanical tendencies he became an enthusiastic automobilist and was inventor of a practicable rotary engine and of several appliances used in connection with automobiles. When the accident happened to the *Titanic*, Colonel Astor directed his wife to dress warmly and saw her placed in one of the life boats, but positively refused to go in himself. Then he took a most active part helping other people into the boats, and when everything was done to save life, calmly awaited the end with others on deck.

J. W. Mack.

Mr. J. W. Mack, secretary and treasurer of the Nathan Manufacturing Company, of New York, died on April 11, in New York City, after a short illness. Mr. Mack had been connected in the official capacity referred to with the company since its organization in 1884. He graduated from the Universities of Heidelberg and Stuttgart, Germany, and came to America while still a young man. He was a son of Dr. Wolfgang Mack, one of the most eminent physicians of his time. Mr. Mack was not only an accomplished engineer, but an eminent linguist, and a public-spirited citizen of his adopted country, and and was especially interested in educational work. He acted for twelve years as school commissioner and was a member of many of the leading societies. In the betterment of the condition of the colored people he spent much time and money.

Charles A. Swan.

Mr. Charles A. Swan, assistant general foreman of the Illinois Central at Centralia, Ill., died suddenly last month in his rooms at the Van Noy Hotel, Centralia. Mr. Swan was in his fifty-ninth year, and was a prominent railway man, holding many responsible positions in the leading western railroads. He was for a number of years general foreman of the Big Four at Springfield, Mo., and latterly master mechanic for the South Dakota Central at Sioux Falls, S. Dak. He was an accomplished mechanic and a genial and courteous gentleman, and his death is very much regretted.

His work was much appreciated among railway men, a faculty for invention being a marked feature of his fine character.

It should be added that he was a worthy member of an engineering family, several of whom were and are still actively engaged in mechanical railroad work in the West and Middle West.

COL. JOHN JACOB ASTOR.

A Wrecked Locomotive.

It lies upon the rocks, a shattered thing,
Here where the valley flood ripped up the rails,
No more the hound that on these modern trails,
Leaped at the whipping steam's fire-furied sting
And scented toward the cities as on wing.
Unwarned, unchecked, with weird, half-human wails,
As some cliff-driven beast of ancient tales
It plunged to ruin past all reckoning;
And on the heap, his face unfrowned by fear,
Calm as a man of marble and as white,
Gripping the throttle, lies the engineer,
Who fell to sleep on his last, frantic flight;
While overhead the solemn stars appear
And this thin gloaming thickens into night.

Railroad Notes.

The Wabash has ordered ten Mikado locomotives from the Baldwin Locomotive Works.

The Union Pacific is planning to add twenty-five switching locomotives to its motive power.

The Great Northern has ordered 25 Mallet locomotives from the Baldwin Locomotive Works.

The Norfolk & Western has ordered 25 Mallet locomotives from the American Locomotive Company.

The St. Louis Terminal has ordered fifteen switching locomotives from the American Locomotive Company.

The Atlanta, Birmingham & Atlantic has ordered ten Mikado locomotives from the Baldwin Locomotive Works.

The Harriman Lines are estimating to add to their locomotive equipment to the extent of at least 150 locomotives.

The Ann Arbor has ordered three superheater Consolidation freight locomotives from the American Locomotive Company.

The Chicago, Milwaukee & St. Paul has ordered fifty superheater Mikado locomotives from the American Locomotive Company.

The Chicago, Burlington & Quincy is estimating on the construction of a new roundhouse and turntable at Broken Bow, Neb.

It is reported that the Seaboard Air Line is estimating on the subject of adding 26 new locomotives to their equipment.

The Northern Pacific will start work this month on the construction of new shops near Spokane, Wash., which cost nearly $500,000.

The Hayden Machinery and Supply Company has ordered four four-wheel switching locomotives from the Baldwin Locomotive Works.

The Kanawha & Michigan has ordered ten Consolidation locomotives and two eight-coupled locomotives from the American Locomotive Company.

The Kenilworth & Helper has been organized in Wyoming and Utah. The chief work will be an extension from Kenilworth Junction to Salt Lake City.

The Federal Cabinet of Australia has decided to call for estimates for the construction of the West Australian railway. The road will extend over 1,000 miles.

The Wichita Falls and Northwestern, now building from Woodward to Forgen, Okla., a distance of about 84 miles, will, it is reported, be finally extended to Denver, Colo.

It is reported from Pittsburgh that improvements to cost more than $6,500,000 are to be made there by the Pennsylvania. Work under way includes three new freight houses.

In May the Great Northern will open the Midland, its new line from the international boundary to Winnipeg, Man., providing a through route from the Twin Cities to that point.

In the last two months the Baldwin Locomotive Works has booked orders for new engines to cost $5,300,000, the last one being for sixty-six Moguls, for which $1,500,000 is to be paid.

The Bahia & Minas Railway of Brazil has ordered three consolidation locomotives from the American Locomotive Company. The weight in working order will approach 50 tons each.

The Manila Railroad, Philippine Islands, has ordered five Consolidation and five ten-wheel locomotives from the American Locomotive Company. These will be equipped with superheaters.

The San Antonio & Aransas Pass are estimating on an extension of the branch line now running from Skidmore to Talfurrias, Tex. The completed extension will be over 50 miles.

The St. Louis & Hannibal is reported to have prepared plans for an extension from Hannibal to Kirkville, Mo., a distance of 75 miles, also to Unionsville, Mo., 35 miles, and thence to Seymour, 35 miles.

The Kansas Southern is to construct a six-stall roundhouse, a machine shop, coaling plant, fuel oil plant, sandhouse and cinder pit, together with a yard having a capacity of about 700 cars at Watts, Okla.

The Denver & Rio Grande contemplate making extensive improvements during the next two years. There will be a considerable enlargement of the shops at Denver, besides double track extensions near Denver.

Eight of the largest type of freight engines of the New York Central have been sent to Lexington, Ky., for the use of the Chesapeake & Ohio. They are not needed

by the Central owing to the coal strike and other causes.

Construction on the first 200 miles of the Saskatoon & Hudson Bay, from Saskatoon to Melfort, is to be begun this summer. The line will go on from Melfort to Le Pas, where it will connect with the Government railway.

The Chicago, St. Paul, Minneapolis & Omaha, it is reported, will build a terminal at Minneapolis, Minn., costing over $1,000,000. It is also planned to erect a new 35 stall roundhouse with machine shop and other additions.

The Central Railway of Brazil has ordered eight locomotives of the Pacific type from the American Locomotive Company. These locomotives in working order will be over 100 tons each, and will be equipped with superheaters.

The railway commissioners of Canada have appointed four locomotive inspectors, one each to be located at Montreal, Toronto, Winnipeg and Calgary. They will occupy positions similar to that of boiler inspectors in the United States.

The Pennsylvania contemplates appropriating a sum approaching $7,000,000 this year in the vicinity of Pittsburgh, Pa. The improvements embrace yard extensions, bridges and freight houses, power plants and improvements in grade crossings.

Articles have been filed at Trenton merging the Mine Hill Railroad, the South Easton & Phillipsburg of New Jersey, and the South Easton & Phillipsburg of Pennsylvania with the Lehigh & Hudson Railway under the name of the Lehigh & Hudson River Railway.

The Newfoundland government has submitted to the legislature of the colony a proposal to sanction the borrowing of sufficient money to carry out the policy of building branch line railways. Instead of an additional 250 miles as contemplated, the new estimate will exceed 350 miles.

Completion of the San Antonio, Rockport & Mexican is assured by the letting of a contract for building 175 miles of the road from San Antonio to Harbor Island. The work is to be completed in eighteen months. The road is promoted by English capital, and is said to have $40,000,000 behind it.

The Pacific Great Eastern Railway chartered at the last session of the Provincial legislature to build a line from Vancouver to connect with the Grand Trunk Pacific, has completed its organization, and the work is expected to be proceeded with during the summer of the present year.

At the present time 3,000 miles of the Southern Pacific main line and second track are protected by automatic block signals, as against 102½ miles, or less than 3 per cent. ten years ago. More than 70 per cent. of the main line mileage has block signals and approximately 100 miles the manual block signal system.

The Westinghouse Air Brake Company has brought out a new device, the use of which will make it possible to send a train of loaded cars down the steepest grade and hold the cars in check with the brakes. It means a saving of thousands of dollars to railroads which now have to sandwich empties with loaded cars to get the same result.

Work is to be begun immediately, it has been authoritatively stated, upon the electrification of the New York, New Haven and Hartford main line between Stamford and New Haven, and the estimates indicate that it will be completed and in operation before the end of the present year. The final estimate fixes the cost at about $4,000,000.

Improvements and purchase of new equipment and motive power in contemplation by the Chicago, Milwaukee & St. Paul Railway call for expenditures of approximately $20,000,000. Of the foregoing amount $10,000,000 will be used for reduction of grades and double tracking on the Council Bluffs division and $5,500,000 will be spent for similar improvements on the Hastings & Dakota division.

It is announced in press dispatches that a contract, valued at about $2,500,000, has been placed by the Canadian Pacific Railway with a firm in New York for the construction of new shops near Calgary, Alberta. The new buildings will include a main locomotive shop, 305 by 712 ft., to accommodate erecting, machine, blacksmith, and boiler shops; tender and wheel shop, L shape, 80 by 240 ft.; storehouse and office building, 60 by 250 ft., in two stories; oil house, 42 by 102 ft.; foundry, 80 by 204 ft.; pattern shop, 30 by 100 ft.; coach-repair and paint shops, 146 by 362 ft.; freight-car repair shop, 231 by 300 ft.; power house, 84 by 104 ft., to provide steam for heating the shops and for other purposes; planing mill, 80 by 300 ft., to contain the woodworking machinery; and mess building, 30 by 150 ft., in two stories. Several of the buildings will be provided with electric traveling cranes and also cranes of the jib pattern, while a high-speed traveling crane of ten tons' capacity will operate in the yard on about 1,200 ft. of track. The work also includes the provision of a 75-ft. transfer table having a capacity of 150 tons, and various small buildings for minor purposes.

Meetings of Erie Mechanical Officials.

A series of meetings of officials belonging to the mechanical department of the Erie Railroad was held at Meadville, Pa., last month. Mr. Wm. Schlafge, general mechanical superintendent, presided and displayed wonderful ingenuity in bringing out the ideas of those present. There were present: Messrs. W. C. Hayes, A. G. Trumbull, E. S. Fitzsimmons, E. A. Wescott, E. G. Chenwett, H. S. Burr, W. S. Cozad, Thomas Tracy, P. J. O'Dea, T. W. Dow, A. Nunn, J. H. Hauck, J. McAllister, W. Patrick, T. J. Cole, C. K. Reasor and P. J. Shaughnessy. Dr. Angus Sinclair, on invitation of Mr. Schlafge, was present at some of the meetings.

The purpose of the meetings was to discuss subjects of interest to the mechanical department and to make suggestions for changes that would result in the betterment of the service. The following subjects were discussed:

Arch Tubes for the support of brick arches has been under investigation for some time. A committee had been appointed to find out the advisability of making these tubes standard. In compliance with the recommendations of that committee the meeting instructed the mechanical engineers to get out a standard practice card.

Air Tools is a subject that is recovering renewed attention. A committee of boilermaker foremen and of tool inspectors was appointed to investigate the advisability of standardizing certain makes of tools to be assigned to certain shops.

Axles: The present specifications require all freight car and tender truck axles to be rough turned entire length. It was unanimously agreed that there was no advantage in rough turning the entire length, and it was agreed to turn only the journal and wheel fit. This will save $2,000 per year.

Owing to the large number of card and shape numbers it has been found necessary to carry in stock a very large number of driving axles. The mechanical engineer has now been instructed to check these cards with a view of reducing the quantity of stock carried.

Failed Parts: The mechanical engineer is making reports of failed parts of car locomotives and other machinery to the general mechanical superintendent which will form the basis of changes being made to strengthen weak parts and forms.

Ash Pan Maintenance and Inspection: Arrangements have been made for keeping proper records of ash pan maintenance at outlying points. This also to apply to ash pans and netting inspection.

Air Hose Soap Suds Test: A soap suds test of all air brake and air signal hose is required. This test must be made with the full standard air brake and air signal pressure. At every point where the necessary facilities are provided, air hose will be tested under card pressure.

Boiler Inspection: Under this heading the prevailing practices regarding boiler inspection were discussed.

Brake Beams: There are now sixteen different forms of brake beams used by the company, and vigorous efforts are going on to reduce the number as low as possible. The use of high-speed brake beams under all passenger equipment will help in reducing the number of types.

Brake Hangers, Brake Levers: Some earnest discussion arose concerning the methods of forging these parts and recommendations were agreed upon that will effect material reductions in cost.

As we think particulars of these discussions are calculated to prove edifying to the same class of officials on other roads we shall continue the reports from time to time.

Chrome Vanadium Steel for Locomotives.

The American Locomotive Company has adopted the practice of using chrome vanadium heat-treated steel as standard practice for locomotive crosshead keys, and will use this steel for all future engines. The keys are drop forged and heat treated, and must meet the following physical requirements:

Elastic limit not under 80,000 lbs. per sq. in.; tensile strength 90,000 to 125,000 lbs. per sq. in.; elongation in 2 ins. not under 20 per cent.; reduction of area not under 50 per cent.

The following test was obtained from one of these keys which was afterward bent cold flat on itself as illustrated. The thickness of this key is 11/16 of an inch:

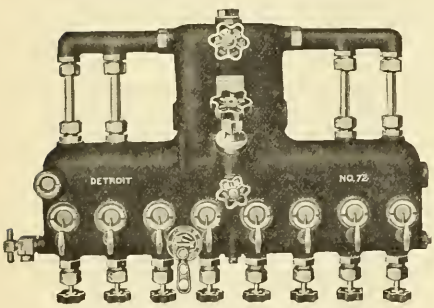
Elastic limit 96,800 lbs. per sq. in.; tensile strength 108,450 lbs. per sq. in.; elongation in 2 ins. 20 per cent.; reduction of area 54.4 per cent.

Engineer Not Engine Driver.

In connection with the agitation among Eastern locomotive engineers to go out on strike, nearly all the newspapers of New York call the engineers "engine drivers," following British practice. Our friend, J. Snowdin Bell, protested very vigorously to certain New York dailies about their habit of putting a slur on locomotive engineers by calling them engine drivers, a sort of menial term, but his protests fell upon unheeding minds, for the editors, one and all, consigned his letters to the waste basket.

New Eight-Feed Detroit Lubricator.

The accompanying illustration shows the new eight-feed Detroit lubricator which is rapidly being placed in service on superheater Mallet compound locomotives. The six outside feeds lead to the high-pressure steam chests and high-pressure cylinders, and the low-pressure steam chests. The two middle feeds can be used for two air pumps, or for one pump and an intercepting valve, or for one pump and a mechanical stoker. The attached control valve permits all of the feeds being started or stopped instantly without disturbing the adjustment of the feed-regulating valves. With the handle of the control valve in the bottom position, all valves are open. A quarter turn closes all valves except the two valves located in the middle. A half turn, or handle in the upper position, closes all valves. The general construction of the lubricator is the same as the older design except in the difference necessitated by the increased number of feeds.



EIGHT-FEED DETROIT LUBRICATOR.

As is well known the ability of the modern locomotive to perform the work for which it is designed is dependent largely upon the proper lubrication of its valves and cylinders. To this end it is necessary to deliver the lubricant under all conditions up to the full efficiency of the locomotive. In heavy, decreased speed the amount of oil should be increased per mile, and on level track at higher speed, it should be decreased to the exact requirements of the service.

The improved devices of the Detroit Lubricator Company have admirably met the requirements of the service, and a degree of economy and convenience of operation has been reached that leaves nothing further to be desired in the lubrication of the modern locomotive. The new eight-feed lubricator completely supplies the needs of the Mallet compound, and it is safe to predict that whatever new forms of frictional parts the undiscovered future of the locomotive may present, the situation will be met with the same degree of ingenuity that so fully meets the case under discussion.

Advertising.

We have repeatedly had reason to believe that American manufacturers of articles intended for railway use in foreign countries can obtain better results by advertising in Railway and Locomotive Engineering than by the use of any other medium. The latest proof of this is a letter from Buker & Carr Mfg. Co., Rochester, N. Y., dated April 4, which reads:

"We have today signed agreement with R. W. Cameron & Co., 23 So. William street, New York, N. Y., making them our sole agents for Australia. They have been doing business with us since the beginning of the current year.

"As it was our ad. in Railway and Locomotive Engineering that established our business in that far-away country, and finally led to the above-mentioned business arrangement we consider it only fair that you should receive credit for your far-reaching influence."

Ajax Plastic Bronze.

Those who are not already familiar with the superior qualities of the Ajax Plastic Bronze should procure a copy of a neat pamphlet just issued by the Ajax Metal Company, Philadelphia, Pa. The metal itself has been on the market for ten years, and the growing demand for its use is the best proof of its superiority. It has not only stood the test, but its manufacturers invite comparative tests. The pamphlet contains full particulars in regard to the tests.

Electric Motors.

Descriptive Leaflet No. 2441, issued by the Westinghouse Electric & Manufacturing Company, is devoted to points of importance in the application of small motors. The various questions of mounting, method of drive and lubrication are discussed. Single-phase and direct-current motors are treated separately and a paragraph is devoted to heating. The publication will prove of interest to central stations and dealers handling motors of small capacity.

McKeen Motor Cars.

The McKeen Motor Car Company have recently opened an office in the Hudson Terminal building, New York, and have appointed Mr. Stephen D. Barnett as Eastern representative. At the present writing there are 122 McKeen motor cars in service in the United States and foreign countries. An order has just been received from the Weatherford, Mineral Wells & Northwestern Railroad for two 70-ft. motor cars.

Rolling Stock Wanted.

The Daily Consular Reports intimate that an official connected with a railway in a Latin-American country has informed an American Consulate that 20 new freight cars and possibly a locomotive will be needed shortly to fill urgent traffic requirements. No specifications have been issued as yet, nor have proposals been called for, but it might be well for American manufacturers to be prepared to submit bids for these supplies. It is also semi-officially announced that about $500,000 will be expended in the improvement of the present lines of railways and the building of new ones. Copy of the report, giving further details, will be sent to interested firms by the Bureau of Manufactures.

Eliminates Staybolt Breakage Zone.

It was decided by a number of professional and practical engineers that the breaking staybolt zone in regular fireboxes is entirely eliminated in the Wood Loco Boilers as proved by the staybolt breakage being nil, on three boilers working under inspection during the past 3 years, on hard road service, with bad water conditions.

The Wood firebox and tube plates are flanged with balanced formations to neutralize strains under which a locomotive boiler works. Three hundred and fifty less stays are required by this formation, and heating surface gained is about 25 per cent., while the added strength is over 50 per cent.

These tube plates and fireboxes cost no more to make than the flanging and riveting of a regular firebox fitted with flexible stays.

Canadian Government Labor Bureau

The provincial government has established a Bureau of Labor in connection with the department of the provincial secretary. For some time past the government has been considering such a step, and the passage of an order in council comes as a result of petitions and requests from labor organizations in the Province.

The duties of the new bureau will include collecting and publishing all information relevant to labor organizations, including the number of men and women employed, the hours engaged, and the scale of wages. All labor difficulties and strikes, as well as the relation of labor to capital, will come under the jurisdiction of the bureau, whose work commences immediately, under charge of a commissioner.

Persons desiring information concerning this bureau should apply to the Secretary, Labor Bureau, Ottawa, Can.

Wood Firebox.

The reports in regard to the Wm. H. Wood locomotive firebox continue to grow in importance, and the claims advanced by the inventor should have the serious attention of railroad superintendents. Every boiler expert who has investigated the Wood firebox agree that it is an improvement of real value.

Removal.

The Railway Materials Company, formerly located in the Old Colony building, Chicago, have removed to more extensive quarters on the second floor of the Railway Exchange, suite 217, Jackson and Michigan boulevards, Chicago. The New York office is located in the Singer building.

Hose Clamps.

The Storrs Mica Company, Owego, N. Y., has taken up the general agency for the railroad trade of the Thompson Indestructible Hose Clamp, made by the Thompson Manufacturing Company, Newark, Ohio. These clamps are made in sizes adapted for use on air brake, air signal, steam and water hose. Sales of this device will be in charge of Charles P. Storrs, manager of the railroad department.

Home Rule Party.

"Is your husband home?"

"Yes; what do you want with him?"

"I'm—er—revising the voting list, and I just wanted to inquire which party he belongs to."

"Do yer? Well, I'm the party wot 'e belongs to."

Scientific Management.

"Now, can ye be tellin' me who thot mon is?" enquired the switchman.

"That's the general superintendent," the yardmaster replied.

"What do you think o' thot? He's a foine-looking mon and ye never would believe the tales ye are after hearin' about 'im."

"What have you heard about him, Mike?" was the curious question.

"Why, they do say that he was at the funeral of Mr. Mitchell's wife, and when the six pallbearers come out he raised his hand and said:'Hold on a minute, boys. I think yez can get along without two of thim.'"

The Proper Name.

Stopping a moment at a town nestling beside the river, and drawing in some deep draughts of pure air—"Isn't this invigorating?" the passenger said to the brakeman.

"No sir, it's Conshohocken," he replied.

The Last Straw.

The sad-faced young man came down the garden path, sombre and sorrowful. The sweet girl watched him with anxious eyes.

"How did father take it?" she asked tremulously.

"He took it—well," came the reply.

"Oh, I'm so glad, George!" she cried excitedly, throwing herself into his arms.

"Are you?" replied George, holding her limply. "Well, I can't say that I am, dearest. At first your father refused to listen to me."

"But didn't you tell him you had $1,000 in the bank?" she exclaimed.

"I did," came the dejected answer, "when all else failed."

"And what did he do then?"

"Do?" echoed the young man wearily. "Why he borrowed it!"

Oshkosh.

"Where are we, Bobby?" she asked.

"I don't know, grandma," answered the little boy.

"Didn't the brakeman say something just now?"

"No. He just stuck his head inside the door and sneezed."

"Help me with these things, Bobby," she exclaimed, hurriedly. "This is Oshkosh. It's where we get off."

Origin of the Sex.

A poet who has been known to tell the truth recounts this story of his little daughter. Her mother overheard her expounding the origin of the sex to her family of dolls. "You see, children," she said, "Adam was a man all alone, and was very lonely, so God put him to sleep, took his brains out, and made a nice lady of them."

An Electric Puzzle.

When George Gibbs was first experimenting with car lighting he had as an assistant a young Irishman called Dennis. The helper was keenly interested in the work and had many questions to ask which his boss answered good naturedly. When the lights were finally shining in splendor, Dennis applied to Mr. Gibbs to answer one more question.

"What I cannot understand," said the helper, "is how you make the ile run along these wires."

The reason so few people get what they want is because they don't want it hard enough to use real effort in bringing things their way.—*Max.*

He only is rich who owns the day, and no one owns the day who allows it to be invaded with worry, fret and anxiety.—*Emerson.*

Master Car Builders' Special.

The Pennsylvania Lines, as formerly, are arranging to provide a special train, which will be known as the Master Car Builders' special. This train will leave Chicago at 3 p. m., Monday, June 10, and is expected to arrive at Atlantic City at 2 p. m. on the day following. The train is especially intended for the accommodation of the members of the American Railway Master Mechanics' Association, the Master Car Builders' Association and the Railway Supply Manufacturers' Association. As already noted in our pages, the conventions of these associations will be held at Atlantic City, N. J., June 12-19. Particulars in regard to special rates and tickets may be secured by application at the ticket office, 242 Clark street, Chicago.

The Valve World.

The April number of *The Valve World*, published by the Crane Company, of Chicago, takes the form of a splendid memorial to Mr. Richard Teller Crane, president and founder of the company, who died last January, as already noted in our columns. The publication extends to 48 pages, and presents a biographical sketch of Mr. Crane's life, with interesting details of the great work that he accomplished. The memorial volume is finely illustrated and is altogether a fitting and eloquent tribute to the memory of a great and good man. We understand that friends desiring copies of this fine memorial of Mr. Crane may be supplied on application to the Crane Co., Chicago.

Promoting Low Rate Injustice.

The latest unfair decision of the Interstate Commerce Commission establishes the far-reaching principle that a railroad must so adjust its rates that justice will be done between communities regardless of the State lines. If a railroad makes a low rate upon traffic wholly within a State, even when forced to do so by a State commission, it must grant the same rate to interstate traffic moving under substantially similar conditions. The principle was laid down by a vote of four to three. The minority held that the powers of Congress were usurped by the majority opinion and that the remedy for such a situation should be applied by additional legislation.

The Railway Man.

The country calls her engineers,
"A task, my lads, for you.
Go, build a track to Further Back,
The wilderness subdue.
Go, bridge the rivers, pierce the hills,
The creeks and gullies span,
All strength belongs to him who wills,
Go, conquer, railway man."

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXV. 114 Liberty Street, New York, June, 1912. No. 6

The Development of the Superheater in Locomotives.

The use of superheated steam in locomotives has passed the experimental stage and like all marked improvements in mechanism the wonder is not so much at the advance made as at the fact that its use was so long delayed. Twenty years have elapsed since Dr. Wilhelm Schmidt, an eminent German engineer, made repeated successful experiments on the use of superheated steam, on stationary engines, and shortly afterwards applied similar devices to locomotives. Of course considerable opposition to the use of superheated steam on locomotives was made, but the result has more than justified the claims of the original promoters. Nearly 10,000 locomotives are now equipped with apparatus designed to increase the temperature of steam during the time of its transition from the dry pipe to the cylinders, and while there are now a number of designs varying in detail from that invented by Dr. Schmidt, the designs as improved by the German scientist bid fair to hold their own, both in point of simplicity in construction and in the potential quality of accomplishment in value of results.

The first forms of superheaters were what may be called of the smoke-box type, the main steam pipe, a dry pipe breaking into a cluster of pipes in the smoke-box, and receiving such extra heat as might be derived from the unused heated air passing out of the flues towards the smoke-stack. The economical advantage was not marked, and the multiplication of jointed pipes in the smoke-box tended to hinder the draft so essential to the process of combustion in the fire-box. Some authorities claim that this organic objection has now been completely overcome. Be this as it may, it is now an undisputed fact that with the appliances now in use a real gain in fuel economy and in tractive power has been made of over 25 per cent. The only offset to this gain is in the cost of the necessary appliances and the maintenance of the same, which it may be stated briefly are gradually diminishing while the gain is apparently increasing.

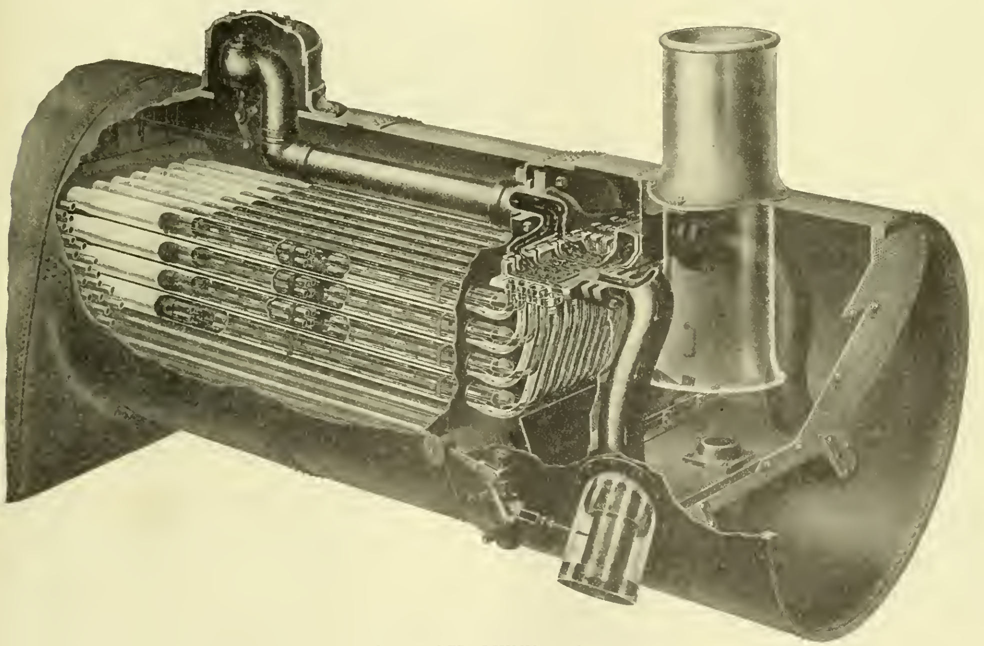


FIG. 1. TOP HEADER, SCHMIDT SUPERHEATER.

To those who may not be familiar with the relation between the pressure and temperature of steam it may be stated that at 170 lbs. of steam pressure per square inch, the steam will maintain a constant temperature of 375 degs. Fahr., and a volume of 2.47 cubic feet per pound. At 200 lbs., pressure the temperature will be 387 degs. Fahr. Assuming that the steam reaches the cylinder at the same temperature as it was in the boiler, the loss of temperature and correspondingly

of pressure is very great, so that of 100 per cent. of steam admitted to the cylinder only 65 per cent. is really available, the average temperature of the steam at the moment of escaping into the exhaust, having been reduced to 230 or 240 degs. Fahr. It can readily be seen therefore that if the temperature can be maintained there would be a considerable gain or maintenance of pressure. Dr. Schmidt's experiments have conclusively demonstrated that at 170 lbs. of pressure 3.50 lbs. of coal will be consumed per horsepower per hour by the use of what is known as saturated steam. If the temperature of the steam is raised by the addition of 80 degs. of heat the coal necessary for the same power per hour will be reduced to 3.40 lbs. If the heat is increased by the addition of 160 degs. the amount of coal required will be reduced to 3 lbs. and if a further increase of temperature is made by the addition of 240 degs., the coal required will be reduced to 2.35 lbs., or about one-third less than by the use of saturated steam, the boiler pressure in both cases being the same.

It would be idle to imagine that there is any increase in pressure of steam as long as the passage to the boiler remains open. That would be a physical impossibility. The increase is in the volume of steam and the opportunity of an increase in volume is given because, the steam having left the boiler, it is no longer in immediate contact with the water, and the temperature may be lowered or raised and the volume diminished or enlarged according to the temperature of the surrounding bodies through which the steam passes. As we have stated the tendency to diminish in temperature and consequently in volume is very great. The temperature may be raised, as is well known, by compression, but this is always at the expense of the working power of the engine. Superheating can therefore be accomplished most effectively by conveying the steam in its passage from the dome to the cylinders as near to the firebox as is possible with safety, and a brief description of Dr. Schmidt's appliances may readily be understood by reference to the accompanying illustrations.

Fig. 1 represents an exposed view of the details of the Schmidt superheaters. It will be noted by observing the arrow points that the steam after passing from the dome along the dry pipe enters a header supported on brackets in the smoke-box, and making a joint with the steam pipe in the same manner as the tee head used in engines using saturated steam. In the bottom or lower face of the header there are a series of openings with means to form joints with coils or units of pipes. Each union leads to a coil of four pipes, each being about 1½ ins. in diameter. To accommodate these four pipes there are a series of enlarged flues about 5½ ins. in diameter, and by following the arrow points it will be noted that the steam is led by the smaller pipes along the interior of the larger flue to a distance of about 2 ft. from the back flue sheet where by means of a thickened U shaped union the steam is returned to the proximity of the header where by means of another U shaped union it is again conveyed to within a short distance of its previous journey and lastly is returned to a receptacle that surrounds the front and sides of the header. This receptacle is an integral part of the header and is furnished with two openings near its sides, the openings being constructed so as to form joints with the branch steam pipes that lead to the cylinders.

The joints of the pipe coils to the lower face of the header are held in place by bolts, the heads of which are shown on the upper face of the header, the lower end of the bolt being threaded and furnished with an adjustable nut. The joint is a ground ball joint, the concave being in the header and the convex attached to the pipe collar. The coiled pipes are thus readily removable. The coils of pipes are kept in place near the upper edge of the enlarged flues by means of lugs that rest on the bottom of the enlarged flues. It will be observed that the large flues, through which the smaller coiled flues pass, are diminished in size as they approach the back flue sheet. This admits of an enlarged water space near the flue sheet besides thickening and strengthening the flue at its junction with the flue sheet.

It will thus be seen that the appliance is simply a means of conveying the steam through a series of small pipes to a point as near the fire-box as safety will permit and by exposing the surface of the small pipes conveying the steam from the dry pipe to the branch steam pipes the temperature of the steam is increased by its near contact with the heated gases finding their way through the enlarged flues. The use of the brick arch in connection with the superheater is favorable to a higher degree of superheat. As is well known, the brick arch acting as a baffle plate and presenting a projected body at a high degree of temperature produces a longer and brighter flame, thereby giving the gases a greater amount of time to mix with the current of oxygen as well as a higher degree of heat to consume the gases and thereby create a more complete degree of combustion. The brick arch also has a tendency to project the flame and hotter gases through the larger flues which are located in the top part of the boiler.

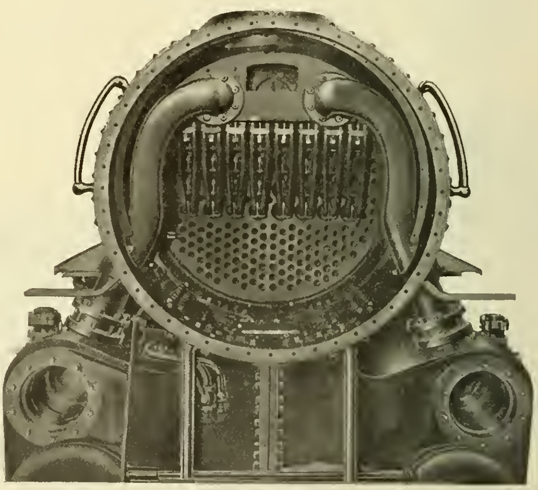


FIG. 2. FRONT VIEW OF SCHMIDT SUPERHEATER.

As may be readily imagined when a locomotive is running with the throttle shut and no steam passing through the coiled pipes, although the fire at such times is not projecting heated air or gases through the flues with such a degree of heat or force as when the repercussions of the exhausted steam is acting as a blast on the fire, there might arise a danger of overheating the coiled flues, and hence the inventors have cleverly devised means to avoid the passage of air or gases through the enlarged superheater flues during the period in which the engine might be running or standing with the throttle shut. The header and attachments being, as already stated, in the upper part of the boiler, it lends itself readily to its enclosure in a casing as shown in Fig. 1. In the bottom of this casing, a damper or adjustable lid is engaged to a movable shaft with attachments outside of the smoke box. The normal position of the damper is open when the throttle valve is open.

It will be noted that the appliance connected with the damper has a controlling attachment to which steam is admitted at such times as when steam is passing into the cylinder. The pressure of the steam at this point causes a partial revolution of the shaft to which the damper is attached, and as long as the steam pressure continues the damper will remain open. When the steam pressure ceases a counterweight attached to a lever on the shaft has the immediate effect of closing the damper and consequently the heated current ceases passing through the enclosed series of flues.

It may be added that the casing surrounding the header and superheater is furnished with suitable hand holes by which inspections may be made, and, as is shown, the branch steam pipes are conveyed through an opening in the wall of the smoke-box directly to the steam chest, the opening being enclosed with a suitable casing on the outer side of the smoke box. This method not only simplifies the construction of cylinder and valve chamber castings, but enlarges the fire-box space, affording a better draft clearance.

Fig. 2 is a front view of the smoke box with superheating casing, exhaust pipe and other attachments removed, showing header with attached superheater flues and also showing lower flues. It will be observed in this illustration that the method of attaching the steam pipes avoids interference with the direct draught of the flues. This is generally admitted to be a marked improvement over the older method of steam pipe connections, not only on account of the fire-box clearance but also preventing any leakage that may occur at the lower joint from interfering with the action of the draught necessary to combustion in the fire-box.

Fig. 3 is another view of the front end with superheater unattached and showing location and number of large flues, and also system of brackets to which superheater header may be attached. This illustration is a reproduction of one of the blue prints of Locomotive No. 1058, and built for the 'Frisco lines by the American Locomotive Company, and described in the May issue of Railway and Locomotive Engineering.

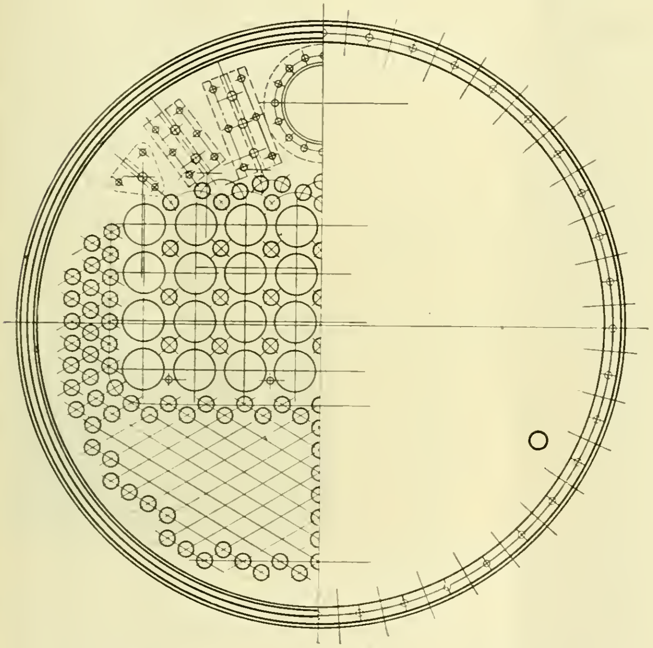


FIG. 3. LOCOMOTIVE BOILER FRONT SHOWING NUMBER AND LOCATION OF SUPERHEATER FLUES.

Having thus briefly described the mechanical construction of the Schmidt superhearters, it may be added that there are now in operation a variety of designs of superheating appliances, all of them possessing features distinctively their own, and meeting with a certain measure of favor, and all tending to show that the use of superheated steam is an important addition to the economical running and increased power of the modern locomotive, and in the near future, the general adoption of the device in locomotive construction is inevitable.

Not Responsible for Inferior Workmen.

Some years ago a judge presiding over a court in Tennessee, at a case wherein the question of a certain railway company's liability was at issue, ruled, and so instructed the jury, that the company was liable, for the simple reason that it did not have the highest grade of employees to protect property in its charge, and a verdict was consequently rendered against the defendant company. The case was, of course, appealed, and when it reached a tribunal that was uninfluenced by local prejudice the former verdict was not only set aside and the company held not liable, but the trial judge was severely criticised for embodying in his charge to the jury instructions that were contrary to public policy. The principal point established by the Supreme Court was that it was impossible for any company, particularly a railway company, to have all first-class employees. It would be contrary to the policy of the railroads to expect to obtain all the best men our country produced, thus casting all the inferior men into other lines of industry.

The Making of Paper.

The fineness to which the rags are ground has no direct influence on the durability of the paper, for even broken cells of linen and hemp remain unchanged for thousands of years in favorable conditions. The employment of strong alkalies and of starch size appears to be the cause of rag paper becoming yellow and brittle, while neutral or mildly alkaline treatment and animal size favor durability. Air drying favors the durability of paper. Even the best rag papers are injured if not destroyed by soaking or excessive dampness. It is impossible to speak with certainty of the durability of modern papers containing few or no rags, as the ultimate effect of the new process of making, sizing, loading and calendering cannot be foreseen. Many new papers have already proved their lack of permanence.

Office Cars.

President Markham of the Illinois Central has issued orders that all private cars of officials of the road shall have the words "private car" effaced, and instead the term "office car" will be painted upon the car. It is planned, as the new name implies, to make the car a traveling office, in which shippers, merchants, or any one having business with the company can feel at perfect liberty to enter at any time. The same invitation is extended to employees in a general announcement which will be made in a few days.

General Foremen's Department

Safety on the Union Pacific.

Editor:

You will be pleased to learn that Mr. J. Kruttschnitt, our director of machinery and operations, has addressed a letter to the president, Mr. A. H. Mohler, calling special attention to the remarkably small number of accident reports. He places special emphasis on the fact that the record is the more remarkable when considered in connection with the very severe weather that we have experienced for many months, and congratulates the employees on the excellent record and expresses a hope that the record will be continued. Copies of the fine letter are posted on the bulletin boards of the various divisions of the Union Pacific Railroad.

It is a proof of the high efficiency of the equipment and track, and the standard of service rendered by the employees, who are not only thoroughly trained to become familiar with the operating and running rules of the road, but are kept alert by a continuation of surprise tests. "Safety" is the watchword of the officials, and the rank and file are alive to it.

Denver, Col. GEO. E. WILLACY.

SADDLE TANK LOCOMOTIVE AND TRAIN. FERROCARRIL DE AMAGA, MEDELIN, COLOMBIA, SO. AM.

Repairing Burst Steam Cylinders of Air Pumps.

Editor:

The winter of 1911-12 was a most severe one on steam cylinders of air pumps, or compressors, on account of the condensation freezing, causing the cylinders to burst. With the right and left-hand cylinders of the 9½-in. and 11-in. pumps, from one-third to one-half of the burst cylinders can be placed in service again as practically new. Where the burst occurs in the right and left main steam passage of the pump, whether there be a crack, series of cracks, or a piece entirely broken out, my method of repairing has been as follows:

Take a gouge, go around the crack or burst part, to make it bright or "metal-clean," mix up "smooth-on" composition to a putty form and work it into the burst part with a putty knife, or some other suitable tool, seeing that the "smooth-on" is driven into the burst part. Dress off the repaired part with more "smooth-on" to make a finish; let it stand for twenty-four hours to give "smooth-on" a chance to metalize. Then blank-off the right-hand port with asbestos, to prevent blocking off the port above the right-hand connection of the cylinder.

Mix up a solution of Portland cement and cast-iron borings of the formula of two parts cement to one part of borings; get this solution mixed to a grout form and pour same into the left-hand connection of the steam port of the cylinder, filling this cavity up to the edge. As the grout solution is drying out, say for couple of hours, take a hammer handle and pack the cement in. Then add more cement to fill up to the edge of the port, put in an 1¼-in. safe plug and let it stand for about six days. It will take about this time to allow it to thoroughly dry out. By the operation, this will make a "right-hand" cylinder.

These directions will also apply to any defect in the steam port that will admit steam to the under-side of the piston when it is on its down-stroke, thereby equalizing the pressure on the steam piston.

I have had two such defects in the past two months at this station and if the directions are followed closely it is a practical and almost permanent repair, not an experiment. I have been repairing burst cylinders in this manner during the past winter and same are still in service, giving good results.

WILLIAM H. HARRIGAN,
Air Brake Repairman.

"Riverside," B. & R. R. Co., Baltimore, Md.

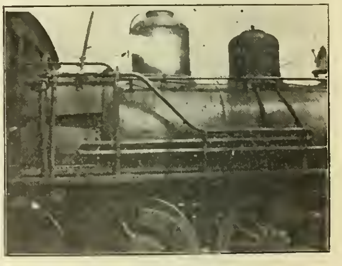
Improved Feed Water Heater.

Editor:

Knowing your warm interest in all new improvements on locomotives I enclose a photograph of the "National Improved Feed Water Heater." The heater has been applied to locomotive No. 305 on the C. & D. branch here, and the reports in regard to its operation are remarkable in point of economy The amounts of coal consumed previous to heater being applied and after were carefully tabulated. In the first instance 212 tons of coal were consumed, and after the heater was applied 162 tons were used. Both periods extended over 30 days.

The amount of water saved in a trip of 14 miles with the heaviest train on this branch after the heater was applied and during all of the switching at Middletown was 1,400 gallons. The train consisted of 22 loads. A careful computation showed a saving of 50,000 gals. of water in 30 days.

Previous to the heater being applied the flues, staybolts, patches and door-ring were caulked more or less every night, the expense estimated between ten and eleven dollars. Since the application of the heater only eight flues had required to be caulked, and the flues have been in service over eighteen months. The reduction in boiler work since the introduction of the heater has exceeded 80 per cent. Mr. J. B. Hunter and Mr. J. Hagerman have been associated with me in perfecting the details of the appliance which so far has exceeded our expectation.



IMPROVED FEED WATER HEATER.

GEO. BICHER.
R. H. Foreman, C., H. & D. Ry.
Hamilton, Ohio.

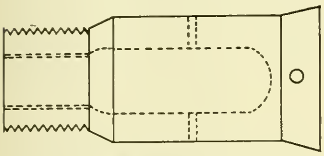
Front End of Main Rods.

Editor:

It is a well-known fact that the key for front end main rod brasses causes a great deal of trouble. It is so easy for an engineer to keep up his brass too tight, that the consequence is worn out brasses, and ruined cross-head pins and holes are very common occurrences. This is expensive work and should be avoided so far as it is possible to do so.

On one of our Southern roads a new idea was tried to prevent this and it worked very well indeed. The main rods had new solid ends put on front

end, and brass, or preferably bronze, bushings put in them. These were pressed in at about 50 tons and rebored afterwards so as to be perfectly true. Then a wrist pin was made just like the ordinary pins with these additional features: A hole was bored in the pin as large as it would stand, as shown in the accompanying sketch, and the



IMPROVED MAIN ROD WRIST PIN.

outside end was threaded for ordinary grease cup plug, with jamb nut on it, two small holes were drilled opposite each other in the center of the bearings so that they faced front and back.

In this way you can get the grease directly on the bearing and keep it lubricated almost perfectly. It is surprising how well the brass will wear, and there is absolutely nothing to cause any trouble as you cannot close the brass any.

The pin is case-hardened, so this will stay in service indefinitely, and when the brass gets to knocking too bad just press in another and bore for fit. Replacing is a small job, but it does not have to be done often if reasonable care is taken in keeping plenty of grease on pin, and the biggest trouble with front end rods has been eliminated.

R. S. Booth.

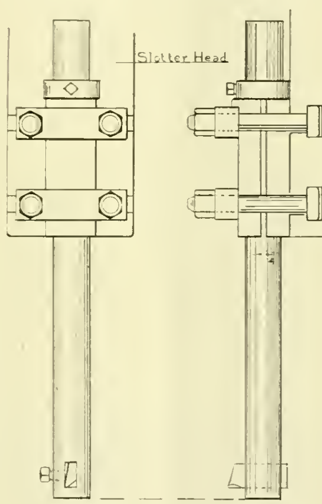
Atlanta, Ga.

Slotter Bar and Piston Rod Remover.

Editor:

Attached print shows slotter tool holder bar which has been received with much favor by all who have had occasion to use the tool. This bar is made of 2¼-in. cold rolled machine steel. A hole is slotted out at the lower end to receive the cutting tool. This slot is ¾ in. by 1½ in. The bar is 30 ins. long and can be readily adjusted for various lengths of work. It is held in place, as is shown in the illustration, by two blocks that are bored out to fit the diameter of the bar, and blocks are held in place by projecting lips at their upper ends that engage in suitable slots on slotter ram or bar. The round tool holder when adjusted for length is held in place by a collar and set screw, as are shown in the illustration. This slotter bar has been found to be very useful for what may be classed as irregular work, as the tool can readily be turned so that the tool can reach any position in a complete circle. This is done by simply loosening the holder clamps and turning the bar until the tool arrives at the position desired. As will be noted, the tool is held in place by an adjustable set screw.

The other drawing shows a piston rod remover adapted to remove pistons from the alligator type of locomotive crossheads. It has the merit of removing the tightest piston without any possibility of damage either to the piston or the crosshead. The piece marked 1 is a piece of steel turned in a lathe to fit exactly in the tapered wrist pin hole, and is similar to the wrist pin, with the exception that it does not require to have a threaded projecting end. It has a groove planed on the flat side 2 ins. wide. This groove is tapered, being deeper at the outer end than at the inner end. Piece marked 2 is a taper key planed to the same degree of taper as the groove in piece 1. Block marked 3 is of such shape and dimensions that it reaches from the point of the piston rod to piece 1, already referred to, and may be so constructed as to rest on crosshead. The taper key is then inserted



TOOL HOLDER BAR.

and driven between 1 and 3, and a separation between the piston and crosshead will be speedily accomplished.

Chas. Markel,
Shop Foreman.

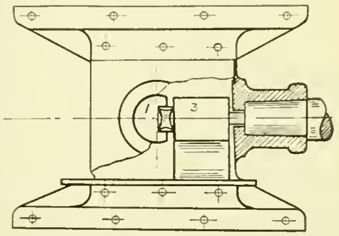
C. & N. W. Ry., Clinton, Iowa.

Leather V. Babbitt.

Editor:

I have had considerable experience with babbitt metal, and the conclusions I have come to I sum up in the following lines: I have known two identical cases on different roads and different build of engines, one a Schenectady, the other a Baldwin, where the main pins ran warm enough to cause considerable anxiety to engineers for several weeks, and in each case the remedy has proved effectual, which was to remove babbitt and substitute leather.

I believe that babbitt in any case is unadvisable on back-end bearings of main rod brasses, even when put in near top and bottom of brass, a strip dovetailed, say of ¾ in. wide; and when put in the way just stated, is the best for the following reason: In case of melting out it



PISTON ROD REMOVER.

can be replaced by leather or sheet rubber, both of them good absorbents of lubricants, and they can be rebabbitted easier than other ways; the most objectionable way is to drill holes all over brass, including crown, for reception of babbitt; in this case, when brass had been hot enough to melt it, there is no other way but to re-babbitt, which takes time, or to do as I did once with the brass, which had bothered us a great deal, on a ten-wheeler main pin—drill holes deeper in crown of brass, tap them and put in brass plugs, then slot brasses as aforesaid and put in leathers. The reason for filling up the crown with plugs was the want of bearing in the right place; we were never troubled with that brass after. But if babbitt is objectionable in rod brasses, when they become hot enough to melt the babbitt, which they do sometimes (every mechanic who has to remove it from driving box while engine was in roundhouse, and, as is generally the case, engine wanted as quick as possible, will agree with this), they fill up oil holes, and the metal, which was put in to save the brass and make it last longer, is the cause, in that case, of wearing it in one trip more than one year's ordinary wear would do.

It is, of course, understood that the rod brass, from the same cause, has the same effect, only in this case it can be got at easier, and in consequence, as a rule, less profanity ensues. This has been my experience with babbitt in the negative; in the affirmative I have found babbitt very useful in conjunction with copper plugs for taking up loss motion laterally, on cross-heads and driving boxes, next to hubs of wheels; have also applied it with success on top of crossheads, where it does good work, and is not as expensive as other metals to apply, taking labor into account; have also used it to advantage, taking up lateral motion, on rod brasses, by drilling holes

around brass and driving in every alternative hole copper plugs, leaving them as much longer as required, to form a dovetailed leaf by riveting with hammer. This not only helps to hold babbitt in place, but makes it wear longer and gives good satisfaction.

Pittsburgh, Pa. R. WATSON.

High-Speed Tool Steels.

By O. H. REYNOLDS.

It may be truly said that if the several brands of high speed steel are legion, so are results obtained by their use, not so much because the steels are so widely variable in endurance under like conditions of work, but from causes directly traceable to heat treatment, to speed and to improper form of cutting edges. The two latter factors and their influence on the efficiency of a tool are of the greatest importance in producing highest output, for a tool may be made to give a fairly satisfactory performance when ground with corner clearance or rake, at the top and side, even though it is too soft to yield maximum work, whereas the same tool must give indifferent results if hardened correctly to give limit output, but is ground with excessive cutting angles, or is subject to an unreasonably high speed.

In general it may be said that the cutting angles have the most influence on the life of the tool for two reasons: first, because the abrasive wear due to the cut must have support under the cutting edge, otherwise the edge is sacrificed without doing useful work, and second, this support is an absolute necessity to resist the enormous down-thrust on the tool when under the stress of heavy cuts. The importance of this load tending to break down the cutting edge of the tool is not appreciated at its correct value, else there would be more attention paid to reduction of front and side rake for heavy work.

It is a fact that with heavy cuts and coarse feeds, the load on the tool is often measured by tons instead of pounds, and it is this enormous load that causes fracture on high speed steel when such steel is hardened at the prescribed limiting heat, say, 2,300 degs. Fah. This is the temperature that makes a tool so hard as to be of a glass-like hardness, and therefore least able to withstand the stresses due to high efficiency work.

The fracture due to this condition may occur as a vertical sliver at the front of tool, or a horizontal flaking off at the top, but oftener the break will manifest itself in a clean fracture, sometimes as far back as the tool clamp. In the latter case several pounds of steel are sacrificed because of the attempt to get the maximum degree of hardness in the tool.

When high speed tools are hardened at too high a temperature it is with the understanding that they will be at their best only after several grindings. The fallacy of this reasoning is apparent when no one would attempt to harden high speed precision tools like reamers, milling cutters or taps at such a heat, not only because the cutting edges would be of no use, but their cutting efficiency would probably be impaired if the edges were intact.

It may be said that such tools are not in the same class with a roughing tool whose sole function is rapid reduction, but the fact remains that the degree of heat which will preserve the cutting edge of a tool and not burn it off, is the heat that will give the highest output, no matter what the character of the work, and that heat is but noted by the aid of a reliable pyrometer, for the reason that the best educated eye falls short of the accuracy of such an instrument. Since the heat which will give the longest life to the cutting edge is that which falls within the fusing point, the pyrometer should be the instrument to determine that heat, for it is the unaided eye that is largely responsible for the widely varying results in hardening high speed steel.

Close observation of methods of heat treatment in different shops cannot but impress one with the need of uniformity, for the measure of highest efficiency of high speed steel is not to be obtained by haphazard or guess work. The breakage referred to above has become a matter of such common occurrence that in repeated experiments with various kinds of steel, I have found that Jessop's is the nearest to perfection, and free from such failure. Breakage of this steel is so rare as to be phenomenal and under the heaviest duty of speeds, feeds and depth of cut.

Complaint of a Hindoo.

Here is the copy of a letter written to the Simla *News* of India by an aggrieved native:

By your kind favor I beg you will kindly make insertions in your world-wide journal of following thoughts what has permeated my mind from too many days since my advent on the hill tops of the summer capital of the Government of India.

From long times I was not come here. In fact, since last time I have not come until this time. And now I am finding that earthquake terrestrial, likewise also official, has become domestic occurrence of daily happening.

Simla is now just the same as is was before time, only some changes was done in and about it. Now in the first place there is Kalka-Simla Railway. It is no doubt a very too clever engineering feat. And on some parts the passengers is experiencing great tumultuousness of thought that I am going to Simla or other world, because on looking down side from the window great hollowness of khuds is the consuming meditation of the mind for time being. Besides there is also numerous disadvantages by the railway, for instance, when fearfulness is the causation of the natural aridity in the throat and the train is stopping too long at stations, no water is able to be catched for quenching of thirstiness and also the train does not always arrive at Simla according to promise at 3:30 p. m., in the afternoon, but sometimes when the "light is low."

7,000-Ton Train.

Through the medium of an immense dynamometer card sent us by Mr. J. F. Walsh, general superintendent of motive power of the Chesapeake & Ohio Railway, we learn some interesting particulars about the performance of one of the Mikado locomotives, illustrated in our columns in October last. The train was one of the heaviest we have ever known as being handled by one engine. There were 110 loaded 50-ton hopper cars, the dynamometer car and caboose, the whole making a train load weighing over 7,000 tons. The engine handled this immense train without difficulty and steamed admirably during the whole trip.

Hard Water.

The hardness of water is usually expressed in degrees, one degree being equivalent to a solution of one part by weight of carbonate of lime or other hardening salts to one hundred thousand parts of water. Wells generally contain the hardest water, 35 degrees of hardness being common. With water of one degree of hardness, the water contained in a single big tender of the Erie Railroad would deposit 75 pounds of mud or scale-making sediment.

Rail Inspection.

Fifteen railroads have adapted the plan of so increasing the number of rail inspectors at the rolling mills, that observation will be taken of the processes as well as tests of the finished product. An inspector will be posted at the converting works, and another in the rolling mill, in addition to those heretofore employed at the testing machines. These increased inspections will apply to twelve mills where rails are made.

Black Metal Polish.

A deep black polish for iron or steel can be made by boiling one part of sulphur in ten parts of oil of turpentine. This mixture should be applied as lightly as possible and heated over a spirit lamp until the required polish develops.

Dedication of Historic Monument on Erie Railroad.

In 1851 Charles Minot was general superintendent of the Erie Railroad. He had been trained as a lawyer, and finding that business too humdrum he gave it up and took to railroad life. Wishing to know the business from the foundation he learned telegraphy and then went to work as a fireman and remained in the mechanical department long enough to acquire some skill in locomotive engine running. Men advanced very rapidly those days.

When Mr. Minot became general superintendent of the Erie he proceeded to establish regular methods of train operating and made rules for the guidance of trainmen that ultimately extended to nearly all the railroads in the country.

One day in 1851 Charles Minot was on a train bound from Piermont to Dunkirk and the train was stopped at Turner to wait for the arrival of an east bound train. Mr. Minot used the telegraph and

TURNER STATION IN 1836.

found that the train to be met had not arrived at Goshen so he wrote the following message: "To Agent and Operator at Goshen, Hold the train for further orders. Conductor and engineer Day Express. Run to Goshen regardless of opposing train."

The engineer of the west bound train refused to run on Mr. Minot's order. He had never heard of such a thing being done and he was not to begin such a dangerous practice. Then Mr. Minot went to the engine and ran it himself, sending the engineer back into the train.

When the train reached Goshen the east bound train had not arrived, so Mr. Minot wired the Agent and Operator at Port Jervis to hold the east-bound train, and pulled out on the western journey. As he entered the yards at Port Jervis the west bound train was coming in at the other end, so that over an hour's delay was saved by this first case of using the telegraph to control the movement of trains. This method of moving trains by telegraph was at once introduced upon the Erie Railroad and in a very few years all the railroads in the country adopted the practice. Andrew Carnegie tells of straightening out a block of trains on the Pennsylvania Railroad two years later by the use of Mr. Minot's method.

About three years ago the story of Mr. Minot's performance was going the rounds of the press through an article that appeared in RAILWAY AND LOCOMOTIVE ENGINEERING, and was taken up by the

MINOT MONUMENT.

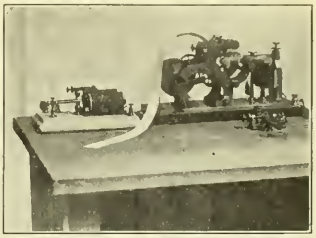
Association of Railway Telegraph Superintendents and also by the Old Time Telegraphers & Historical Association, both of which organizations labored zealously to inaugurate a movement for the erection of a monument commemorating Mr. Minot's historical action. We do not know who the numerous telegraphers were that labored on pushing this movement, but we are certain that Col. E. P. Griffith, telegraph superintendent of the Erie, was in the lead and was chairman of the committee representing an organization formed to erect a suitable monument to Charles Minot.

The outcome of this movement has been the erection of a granite monument and tablet near Harriman station, which was formerly Turner. The monument was quarried on the Harriman estate and was contributed finished by Mrs. E. H. Harriman. Secured on the monument is a bronze tablet bearing the inscription, "From this station, Charles Minot, general superintendent New York & Erie Railroad, 1851, issued the first train order transmitted by telegraph." At the top of the tablet encircled by a wreath is a vignette of Mr. Minot.

On May 2 a large and distinguished company assembled at Harriman station to witness the unveiling of the monument, that part having been done by Miss Gertrude M. Griffith, daughter of Colonel Griffith, who had labored so assiduously to bring the event to a successful conclusion. A special train from New York had brought a concourse of people and all the school children in the neighborhood arrayed in gala dress were onlookers.

Among the people looking on were Frederick D. Underwood, president Erie Railroad, accompanied by Mrs. E. H. Harriman, Thomas A. Edison, Mrs. George C. Minot, and two other neices of Charles Minot; W. J. Harahan, vice-president Erie Railroad; George N. Orcutt, general attorney Erie Railroad, and many others.

The proceedings began with prayer and music, after which Col. Griffith in a short address outlined the history of the



KEY, RELAY AND REGISTER.

monument, and then introduced Mr. Harry D. Estabrook, orator of the day.

Through the courtesy of the publishers of the Erie Railroad Employees' Magazine we are able to show illustrations of Turner Station, as it appeared in 1836; of a telegraph key, relay and register of the form used by Mr. Minot, of the Minot monument and of Harriman station while the ceremony of unveiling the monument were going on.

DEDICATION OF HISTORIC MONUMENT, MAY 2, 1912.

4-6-2 Type of Locomotive, for the Central of Georgia Railway

It is of interest to observe that among the various changes that are being introduced into locomotives of recent constructions many valuable improvements are the devices of the leading railway men engaged on the railroads to the service of which the locomotives are built. In February, 1909, the Central of Georgia equipped a Consolidation type locomotive with a novel arrangement of fire box and combustion chamber which had been designed by Mr. F. F. Gaines, superintendent of motive power. This engine, during three years of service, has given no trouble from leaking tubes or steam failures, and furthermore has effected a considerable economy in fuel. Due to its success, similar fireboxes have been applied to six-passenger locomotives of the Pacific type which have recently been completed by the Baldwin Locomotive Works.

In designing the Gaines firebox, the special objects kept in view were to provide sufficient volume for complete combustion of the gases, to admit the necessary quantity of air to effect such combustion, and to direct the course of the gases so that the entire area of the firebox shell would be useful as heating surface. At the same time the furnace was so designed as to avoid troubles from leakage, such as sometimes occur in Wootten boilers having combustion chambers extending forward into the boiler barrel. In the new Pacific type locomotives the firebox shell bears a close resemblance to the modified Wootten type, as built with a straight tube sheet and sloping back head. The throat is extremely shallow, and the mud ring, which is horizontal, is supported on expansion plates at the front and back. A brick wall is built across the furnace, leaving a space 31 ins. long between its front face and the tube sheet. This brick wall is carried on a cast steel bearer, which also serves as a support for the mud ring. The bearer in turn slides on a cast steel frame brace, which is bolted to both the upper and lower frame rails.

An essential feature of this furnace is an arrangement whereby pre-heated air is made to mingle with the gases as they pass over the top of the wall into the combustion chamber. The air openings are five in number and they are placed 14 ins. apart transversely. They communicate, by vertical ducts formed in the bricks, with 2½-in. pipes, which are curved forward at their lower ends and are provided with funnel-shaped mouths. The air, in its passage upward through the wall, is heated to a high temperature. As it enters the furnace it is projected backwards by an overhanging ledge of fire brick, and becomes thoroughly mixed with the gases before the latter enter the combustion chamber. The effect of this rearward deflection of the currents of heated air is to cause the flame and hot gases to fill the upper part of the furnace at the back.

The lower part of the combustion chamber is lined with fire-brick. The walls slope at a steep angle, and any cinders which may accumulate are discharged into a hopper, from which they can be easily removed. It is found in practice, that comparatively few cinders are trapped in this way. It is also found that this type of furnace is practically smokeless, even when burning coal having approximately 30 per cent. volatile combustible matter, thus showing that combustion is unusually complete.

The grate is divided, by a longitudinal bearer, into two sections; and the bars in each section are coupled to rock in two groups. The height at which the grate is placed allows room, over the trailing truck, for an unusually deep hopper ash pan.

These are the first locomotives to use the Gaines type of furnace in combination with a superheater, and their performance will be watched with interest. In view of the experience previously acquired on the Central of Georgia, there is every reason to believe that the new engines will be reliable in service and economical in fuel and water consumption.

The following are the principal dimensions of this type of locomotive:

Gauge.—4 ft. 8½ ins.

Cylinders.—23 ins. x 28 ins.

Valves.—Balanced piston.

Boiler.—Type, straight; material, steel; diameter, 70 ins.; thickness of sheets, ⅝ in.; working pressure, 180 lbs.; fuel, soft coal; staying, radial.

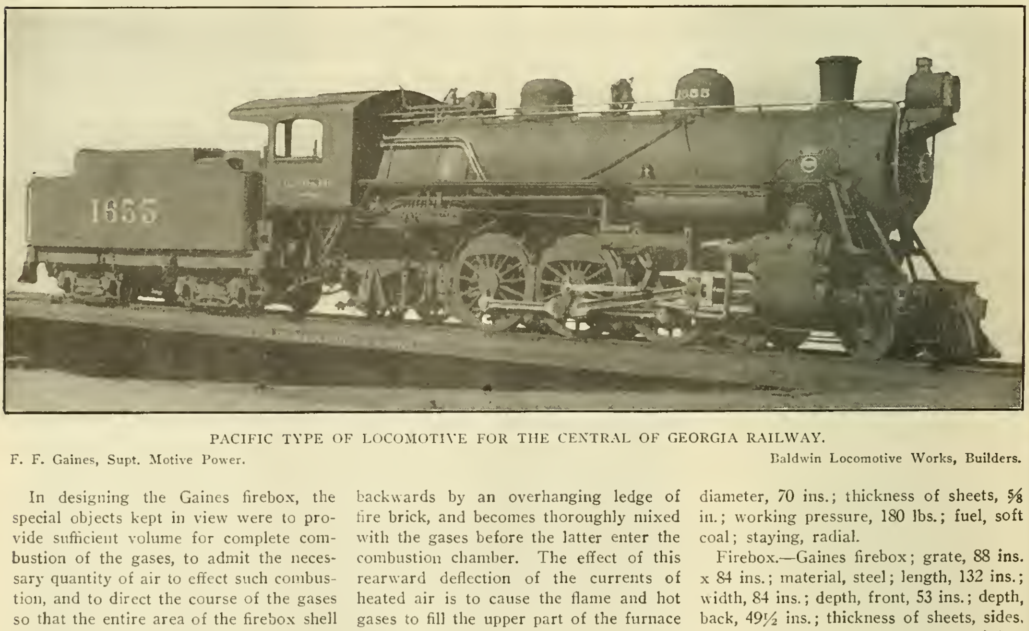
Firebox.—Gaines firebox; grate, 88 ins. x 84 ins.; material, steel; length, 132 ins.; width, 84 ins.; depth, front, 53 ins.; depth, back, 49½ ins.; thickness of sheets, sides, ⅜ in.; thickness of sheets, back, ⅜ in.; thickness of sheets, crown, ⅜ in.; thickness of sheets, tube, ½ in.

Water Space.—Front, 4½ ins.; sides, 3½ ins.; back, 3½ ins..

Tubes.—Material, steel and iron; thickness, No. 9 W. G. steel; No. 12 W. G. iron; number 28, steel, 194 iron; diameter, 5⅜ ins. steel, 2 ins. iron; length, 18 ft. 0 in.

Heating surface.—Firebox, 163 sq. ft.; tubes, 2,526 sq. ft.; total, 2,689 sq. ft. grate area, 58.3 sq. ft.

Driving Wheels.—Diameter, outside,



PACIFIC TYPE OF LOCOMOTIVE FOR THE CENTRAL OF GEORGIA RAILWAY.

F. F. Gaines, Supt. Motive Power. Baldwin Locomotive Works, Builders.

69 ins.; diameter, center, 62 ins.; journals, main and others, 10 ins. x 12 ins.

Engine Truck Wheels.—Diameter, front, 33½ ins.; journals, 6 ins. x 12 ins.; diameter, back, 48 ins.; journals, 8 ins. x 14 ins.

Wheel base.—Driving, 12 ft.; rigid, 12 ft.; total engine, 31 ft. 6 ins.; total engine and tender, 63 ft. 9½ ins.

Weight.—On driving wheels, 134,850 lbs.; on truck, front, 43,150 lbs.; on truck, back, 44,300 lbs.; total engine, 222,-300 lbs.; total engine and tender, 360,-000 lbs.

Tender.—Wheels, number, 8; wheels, diameter, 33 ins.; journals, 5½ ins. x 10 ins.; tank capacity, 7,500 gals.; fuel capacity, 13 tons; Service, passenger.

Engine equipped with Schmidt superheater. Superheating surface, 605 sq. ft.

Unearthing an Ancient American City.

The secret of the first peopling of America is expected to be read in the inscriptions found among the ruins of Quirigua, the ancient Maya city of what is now a tropical jungle of Guatemala, sixty miles inland from the Caribbean Sea.

This city is being uncovered from the debris and growth of centuries by E. L. Hewett, of the Archæological Institute of America, whose researches have added greatly to the antiquities already in the possession of the institute.

The temple walls and hieroglyphic-covered monuments already brought to light are claimed to show a civilization superior to that of ancient Egypt, and the city is thought to have flourished in the time of old Rome.

The conditions of existence in ancient Guatemala were said to resemble those of ancient Egypt except that there was no great river, and the resulting civilization was similar. It will be interesting to receive particulars of the tools and implements used among these pioneer Americans, and it is expected that there will be an exhibition at an early date.

French Passenger Locomotive

Some idea of the peculiarities exhibited in locomotive construction in France may be gathered from the accompanying illustration of an eight-wheel passenger locomotive, a number of which are in operation on the Eastern railway of France. They are equipped with what is known as the Flamand boiler, consisting of a superimposed receptacle over the boiler proper, and which is claimed to give a degree of dryness to the steam unknown even in superheated appliances. Whatever merit there may be in this apparently cumbrous attachment, their steaming qualities are of the best, and while their tractive power is not great, the comparatively short stroke of the piston, together with the large diameter of the driving wheels, gives them a velocity which on the level stretches of Eastern France is something that, if all reports are true, are not equalled in any other part of the world. The workmanship is exquisite in finish, the polished parts shining like burnished silver. As for the boilers, if the insides are as clean as the outsides, their steaming qualities should not be wondered at. As will be noted the valve gear is of the outside double-eccentric type, being readily reached and easy of adjustment.

EIGHT-WHEEL PASSENGER LOCOMOTIVE FOR THE EASTERN RAILWAY OF FRANCE.

The following are the principal dimensions of this type of locomotive:

Cylinders—18½ ins. by 26 ins.

Diameter of driving wheels—6 ft. 10¼ ins.

Diameter of truck wheels—3 ft. 5¾ ins.

Working pressure of boiler—170 lbs. per sq. in.

Heating surface—Firebox, 146½ sq. ft.; flues, 1,665 ft.; total, 1,811½ ft.

Grate area—26¼ ft.

Capacity of tender—Water, 4,408 gals.; coal, 5¾ tons; wheelbase, 24 ft. 5⅜ ins.; tender, 12 ft. 9½ ins.; length over buffers, engine, 34 ft. 2¼ ins.; tender, 24 ft. 1⅛ ins.

Weight in working order—Engine, 55 tons, 17 cwt. 2 qrs.; tender, 43 tons, 12 cwt. 1 qr.; total weight, 99 tons, 9 cwt. 3 qrs.

Railway Extension in China.

We have received letters repeatedly from railway men troubled with the wanderlust asking what prospects there would be for them in China, where considerable railway extension is in progress. Our earnest advice to these people is stay where the stars and stripes wave over railroad operating methods with which you are familiar.

In reply to questions about railway extension in China we quote a late report from Consul General Bergholz, Canton, published in the Daily Consular Report as follows:

The destiny of the Canton-Macao Railway lies with a group of local Chinese, who are now advertising in native papers for capital with fair success. The route has already been surveyed and it is probable that construction work will be commenced at an early date. Starting at Fati, across the river from Canton, the line will run almost due south, through the districts of Shuntak and Heungshan, to the boundary of the Portuguese colony of Macao. It will be about seventy miles long and will penetrate one of the richest districts of South China.

The country through which it passes is low lying, intersected by innumerable creeks and given over to rice, fruit and vegetable culture. A thirty-mile branch will connect the main line at Chentsun with the Sunning Railway at Kongmoon, via Kaukong.

There are no very large cities on the railway, but there are innumerable villages and several towns of 10,000 to 50,000 people, among which may be mentioned Chentsun, Shuntak, Heungshan, Chingshan, Kamchuk and Kaukong, the last two of which are ports of call for foreign steamers plying on the West River. The southern terminus of the

main line will be within five miles of the new commercial port of Heungchow, now in process of construction, and will undoubtedly have some effect in hastening the completion of that pretentious scheme.

The people of the Shuntak and Heungshan districts are wide awake and progressive, and have come under the influence of a large number of Chinese returned from abroad. There are probably no richer districts agriculturally in China.

So dense, however, is the population that large quantities of rice have to be imported from abroad to help out the local crops.

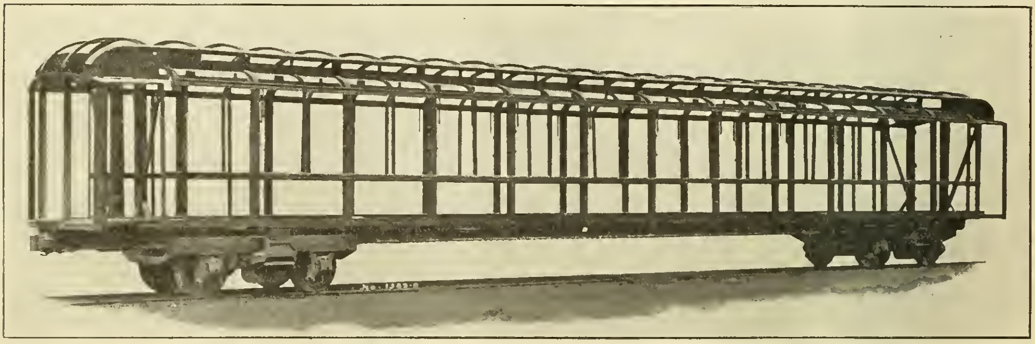
The construction of a railway from Shekwan, across the East River from Shek Lung on the Canton-Kowloon Railway, to Amoy has been under consideration for a number of years, and in 1906 a survey of the route was made. The line is to be built by Chinese syndicates representing the people of the two provinces through which it will pass—Kwangtung and Fukien. No advance has been made beyond the survey of the line, and it is probable than some years have still to elapse before construction work actually commences. The line will have a length of 275 miles in Kwangtung and about 100 miles in Fukien. It will penetrate a thickly populated country in a high state of cultivation, and will bring rail communication to several important cities now served only by inferior waterways.

The government of Nicaragua, which owns and operates the railways in the country, has decided to use oil fuel exclusively in the locomotives. To provide storage for the oil the government has had erected at Corinto a steel tank with a capacity of 1,554,000 gallons.

The new Orleans, Mobile & Chicago has ordered eight Mikado and four Pacific locomotives from the Baldwin Locomotive Works.

Pennsylvania All Steel Passengers Cars

Through the process of evolution of railway rolling stock, the passenger car of today is made of steel and combines the strength and lightness of the strongest material science and invention have yet given to the world. We are presenting to our readers three engravings, illustrating the latest design of an all-steel passenger car, built by the Pressed Steel Car Company for the Pennsylvania Railroad.



EXTERIOR VIEW OF STEEL CAR FRAME.

All intelligent railway people are becoming keenly interested in the construction details of steel cars, a fact which moves us to publish these illustrations. We can think of no illustration calculated to be more instructive than these to people interesting themselves in the outlines and details of steel-car construction.

During the past winter the all-steel passenger cars, that are now becoming very numerous on the Pennsylvania Railroad, have displayed their valuable life-saving properties. The illustrations show how the cars are put together, and a student can readily identify the strength-producing details that have been so thoroughly tested and have never been found wanting.

It may be added that the number of steel cars under construction, and about to be constructed during the present year, exceeds that of any other two years since the construction of steel cars began, and a larger increase in the future seems assured.

INTERIOR VIEW OF STEEL CAR FRAME.

The Monongahela has ordered six consolidation locomotives from the American Locomotive Company. The weight in working order will approach 200,000 lbs.

Chemical Laboratory in Baggage Car.

When boys or young men become infatuated with the study of chemistry, it frequently carries them into very foolish experiments. The first work that Thomas A. Edison got to do was filling the position of train newsboy, known in the west as "the butcher." Thomas had fallen into the habit of studying chemistry which could not be pursued to advantage without an experimental laboratory. Thomas kept an experimenting laboratory in the baggage car, by courtesy of a good-natured trainman. One day one of his experiments resulted, as experiments sometimes do, in an unexpected explosion, and the car and its contents were badly damaged. Needless to say, Tommy was forbidden to reconstruct his laboratory in the car.

Education of Thomas A. Edison.

A letter of encouragement to the school children of New Jersey has been written by Thomas A. Edison. It reads as follows:

Dear Young Friends: I have been asked to write a letter to the boys and girls in the grammar schools in New Jersey, telling something of my own school days. Such a letter as that would be very short, for I really never had any school days as you understand them.

I was rather delicate when a small boy, and instead of sending me to school my mother, who had been a high school teacher, educated me herself at home. She had only the one pupil, which was fortunate for me, as I received thoroughly sound teaching. My mother also taught me how to read good books quickly and correctly, and as this opened up a great world in literature, I have always been very thankful for this early training.

I was fond of experimenting, so, when I was 12 years old I got work as a train newsboy in order to earn my own pocket money to buy chemicals and apparatus with which to experiment. My train ran from Port Huron to Detroit, and this gave me opportunity to go to the library in the latter city and read books that could not be found in Port Huron, where I lived.

I always kept busy and had lots of adventures in trying to add to my store of knowledge, but to tell you the whole story would make my letter too long.

School days are very different from what they were when I was a boy, fifty years ago. You now have beautiful school buildings, with modern conveniences and apparatus, and your studies include many interesting subjects relating to the arts and sciences. It seems to me that the boys and girls of the present time ought to be very happy in having these fine opportunities of preparing to do big things in the world.

Charges for Lost Checks Illegal.

Railroad companies have lately received notice from the Interstate Commerce Commission that the practice of charging 50 cents for a lost baggage check and 25 cents demurrage per night for left baggage is not legal and need not be paid.

A traveler on one of the trunk lines lost his pocketbook which contained the check for his trunk. The railroad company would not deliver the trunk till the owner paid 50 cents for the lost check and they charged 25 cents for the trunk having been left in the baggage room one night. An appeal to the Interstate Commerce Commission brought out the decision named.

INTERIOR VIEW OF FINISHED STEEL CAR.

The United States Geological Survey has issued a chart which shows the amount of coal mined by States. In the year 1814 only 22 tons of coal were mined, but by 1850 this had increased to over 7,000,000 tons yearly and in 1910 nearly 502,000,000 tons were taken from the ground. The total amount mined in the United States is 8,250,000,000 tons.

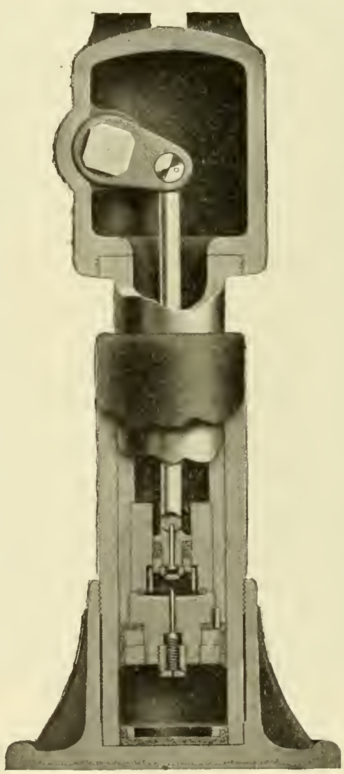
General Foreman's Dept.

The Hydraulic Jack.

ITS INVENTION, CONSTRUCTION AND MAINTENANCE.

Some inventions are, properly speaking, merely improvements on something already in use, and it is often difficult to ascribe to any particular individual the crowning merit of having brought into use something of real value in the doing of the world's work. In the invention of the hydraulic jack and its practical application there is no controversy. Richard Dudgeon, a young Scottish machinist who came to America near the middle of the last century, was working in a roundhouse in North Carolina. The day was hot. The screw jacks used in lifting the locomotives were hard to turn. The sweat rolled in great globules down the honest face of the earnest mechanic. An inspiration came to him. He was fond of books and had read of the discovery by the celebrated French philosopher, Blaise Pascal, that water enclosed in a vessel and pressure applied the pressure is transmitted equally in all directions. He had also seen the hydraulic press, the invention of Joseph Bramah, in England, in 1795, in operation, and the idea occurred to Dudgeon that the principle could be utilized in a portable jack, self-contained, and capable of not only exercising the functions of a hydraulic ram by means of an internal force pump, but also possess the capability of returning the liquid from the ram chamber to the reservoir in lowering the ram. The young mechanic proceeded in his leisure hours to construct the first hydraulic jack. It was patented by him in 1851, and while he met with the usual difficulties common to all inventors, it gradually grew in favor, and the inventor was soon able to establish a workshop in New York for the manufacture of the jacks, and where, in connection with other of his clever mechanical inventions, the work is still carried on with constantly increasing success. Like James Watt, the inventor of the steam engine, Dudgeon was reluctantly compelled to bring suits against several imitators, who infringed on his patents, and it is gratifying to know that the courts decided in his favor in every instance.

The introduction of the hydraulic jack into England was also made by Mr. Dudgeon, and a new host of imitators arose. Doubtless they also could have been fought to a standstill, but the inventor had not time to waste his energies in tedious lawsuits. Other inventions were coming from his clever hands, among which was the flue expander, which also met and still meets with great popular favor. It is interesting to learn that in the launching of the *Great Eastern* steamship it was found that the enormous weight of the vessel had caused a sinking of the under supports, and the launching of the great ship seemed for some time a physical impossibility. An English engineer, Richard Tangye, who had made a trifling change on some little detail in Dudgeon's jack constructed a set of jacks that succeeded in successfully launching the ship, and Brunel, the constructor of the ship, publicly ascribed the success of the launching to Dudgeon's masterly invention.



HYDRAULIC JACK.

Coming to the construction of the hydraulic jack as generally used in locomotive work, the complete details are almost all shown in the accompanying illustration. It will be observed that the head and interior tube form separate reservoirs. In the middle reservoir a force pump of simple construction is located with two automatic valves so arranged that on the downward stroke of the plunger the pressure of the liquid beneath closes the upper valve and opens the lower one. In the upward stroke of the plunger the upper valve opens, while the pressure of the liquid in the lower reservoir closes the lower valve. The plunger is operated by a short crank, the axle of which projects through the head of the ram and is adapted to receive a lever which is operated by hand. It will thus be readily observed that if the valves are properly fitted to their bearings the reciprocating action of the plunger will have the effect of pumping the liquid contained in the upper reservoir into the lower reservoir, the amount pumped at each stroke being equal to the amount of space traversed by the plunger and attached valve in the inner or middle reservoir. Following this simple operation it will be seen that as the inner tube is slidably fitted into the outer shell, it will be compelled to rise in order to make room for the liquid forcibly pumped into the lower reservoir. The increase in lifting power is an exact ratio between the size of the plunger or piston with its attached valve and the size of the piston to which the lifting ram is attached. Thus if the diameter of the pump piston is one inch and the diameter of the lifting piston is four inches the area or under-face of the ram will be sixteen times that of the pump piston; and if a load of three tons is applied to the pump piston by means of the lever already referred to the ram will exert a lifting force of forty-eight tons.

It will be readily noted that in this enormous increase of power there is a corresponding diminution of velocity. When the power is multiplied, as in the instance given, sixteen times, the inner or pump piston will have traversed thirty-two times further through its working space than the outer piston or ram has done, as it is in the downward stroke only that the pump forces the liquid into the lower reservoir, the upper or suction stroke of the inner piston being necessary in opening the upper valve and allowing the liquid in the upper reservoir to flow into the second or smaller res-

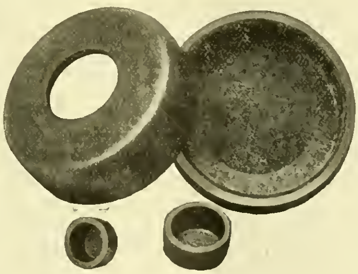
ervoir preparatory to being forced through the lower valve opening into the lower reservoir.

Turning our attention to the lowering of the jack, it will be observed in the illustration that if the inner piston is lowered a sufficient distance its lower extremity will touch the extreme or upper end of the lower valve stem thus opening both valves, the suction or piston valve by the stem, and the pressure or pump valve by the piston. This method was improved upon by Mr. Dudgeon in 1873, by enlarging the area of the lower part of the inner reservoir and so allowing the liquid to flow past the lowered piston. Although this was a marked improvement it subjected the packing to occasional distortion on account of the swelling of the leather band, which will be described further on, and a still better improvement was perfected in 1884, whereby the enlarged recess at the base of the piston was omitted, and in its stead passages were formed in the walls of the pump to allow the liquid to flow around the piston packing when the plunger or piston was lowered the desired distance. Many of the earlier forms of Dudgeon's jacks are still in use, and are the best proof of the durability of the jack even without the more recent marked improvements.

Other improvements have been added, the doubling of the valves being an important addition by means of which the lowering of the jack could be accomplished at a much higher speed than with the earlier forms of the jack, as well as a more rapid raising in case of lighter loads. It is but justice, however, to state that in these and other improvements the principle of the original jack as invented by Mr. Dudgeon has met with no kind of organic change. The forms and some of the lesser details have been modified or adapted to the special work occasioned by the outgrowth and increased weight of the mechanical appliances to which their use was such a necessary adjunct. Besides the double pump jack, the horizontal jack, another new adaptation, possesses the desirable quality of working in any position. In these latter improvements it should be added that Mr. Dudgeon has been peculiarly fortunate in his choice of assistants and successors. The desire for jacks for heavier and multiplex service has been skilfully met, and Mr. Dettmar and latterly Mr. Nelson have shown themselves clever adapters of Mr. Dudgeon's invention to any emergency that has arisen.

Probably the limit of improvement has been reached in what is known as the "Universal" jack. It is the latest improved type of jack and embodies features that have been suggested by long experience. It is furnished with double pumps, so that if the load is light, or if the ram must be extended some distance before the strain commences, the two pumps can be used together until the strain becomes heavy, when one pump is thrown out by a turn of a small handle. Reversing the operation throws both pumps into service again. This jack can be operated at any angle, and may be lowered either in the usual way by a lever or valve handle and can be furnished to lower by one or both methods. It has the elements of simplicity and flexibility in a marked degree.

Regarding the repair or maintenance of the hydraulic jack, it may be stated at the outset that while there are few mechanical devices that possess the elements of endurance as strongly as it does, it will not last forever. In its failure it has the rare faculty of invariably indicating the cause to the intelligent mechanic. It will not work if it is not supplied with liquid. Even



RAM AND BOTTOM PACKING.

if completely air tight the common atmosphere is too elastic. If the valves are not tight the liquid will escape and the point of escape is readily detected. In pressing down the lever and letting it go, if the lever rises of its own accord the lower valve is leaking and should be re-ground. This can readily be accomplished by removing the parts and grinding the valves in the seat by an application of emery and oil. There is usually a notch in the end of the lower valve spindle, suitable for inserting the point of a screw-driver, and the refitting is easy. If the upper valve is leaking there will be an overflow around the inner edge of the outside cylinder. If the jack raises and will not lower, the stem of the lower valve is too short and a new valve should replace the older one. A temporary makeshift may be made by adding a little solder to the end of the stem, but this is not advisable.

A packing ring of leather is fitted completely around the lower part of the ram and is held in place by being lapped over and held in place by a threaded metallic ring. In the event of the leather packing becoming dry it is easily damaged and will occasion leakage around the inner edge of the outer cylinder similar to a leak in the upper valve. In drawing the ram out of the cylinder it is necessary to open the valves, as the air aids in the resistence in withdrawing the ram, and in any event it may be necessary to hold the base of the jack in a vise and use a lever in removing the ram. A leather washer or packing is also used around the plunger or piston and though less subject to deterioration than the larger packing around the base of the ram, is also subject to drying or cutting by the admission of metallic or other hard particles, and in this connection it should be observed that the liquid placed in the jack should be carefully strained before being poured into the jack.

The best liquid mixture has been found to be about two parts of water mixed with one part of grain alcohol. This will not freeze, nor corrode, nor thicken, and has a preservative effect on the leather packing, but like all liquids passes away in time by the process of evaporation. Jacks, when repaired, should be tested by remaining under safe weight for several hours. This will have the effect of expanding and tightening the packing. When filling the jack with liquid and when not in use it should always be lowered. Sudden jerks should be avoided as there is a limit to the resistance of even the strongest parts, while the lighter parts may be irreparably damaged.

Locomotive Lubrication.

Editor:

I have read with much interest the article in the General Foreman's Department of your current issue on Force Feed Lubrication of locomotive journal boxes. Here are, however, a few things that are not exactly clear to me and on which I should be glad to have comment in the same column.

Is it not a fact that water will stand greater pressure than oil? If so, is it exactly fair to draw a comparison between the lubrication of Swiss turbines by water under hydraulic pressure and the lubrication of locomotives by means of oil under force feed? Is it not a fact that grease is used for the latter purpose because oil does not stand the bearing pressure? Again, if oil will not stand the bearing pressure alone, will it stand the additional pressure administered under force feed? I know of no oil that will stand the pressure instanced in this article, that is, 400 lbs. per square inch. I should like to

know what oil is used in the McCord Lubricator. Is it especially prepared for this use? If the bearing is floated on the journal, will not oil of ordinary viscosity escape at the bottom of the bearing? If oil of sufficient viscosity not to escape is used, will it not increase the friction load of the locomotive?

What is the cost per thousand miles per driving box journal when McCord Lubricating System is used? What is the average life or mileage of brasses lubricated by the McCord System? J. T. Butler.

Abington, Pa., April 29, 1912.

The above letter was submitted to McCord & Co., Chicago, Ill., and we take pleasure in publishing the reply sent to us by one of the leading experts in that enterprising firm. It contains much information that cannot fail to be of interest to all who are seeking information on the important subject of lubrication.—Ed.

Reply of McCord and Co.

Railway and Locomotive Engineering, New York, N. Y.:

Gentlemen.—We are in receipt of a copy letter written to you by Mr. J. T. Butler, of Abington, Pa., in connection with the article appearing in your April issue on the subject of the McCord system of lubrication. We beg to submit the following reply to the questions raised by Mr. Butler.

Water is less compressible than oil, and therefore will stand a higher pressure per square inch for the same degree of compression, but the step bearings on the Swiss vertical turbines mentioned could be lubricated by pumping oil into them just as well as by water, the difference being that probably a somewhat larger volume of oil would be required than of water. It is perfectly fair to draw comparisons between the turbine lubrication by water under pressure and the locomotive lubrication by oil under pressure, because in each case the bearing surfaces run on a film of liquid.

Grease has been used on driving boxes by some roads not because oil would not stand the bearing pressure, but because grease allows the use of a spring which held the grease in contact with the journal at all times. One of the difficulties of lubricating locomotive journals by means of oil fed to the bearing surfaces from below by the capillary attraction of the waste was that unless the waste in the cellar was stirred up frequently and kept in contact with the journal, it would sag down and the journal would get no oil delivered to it. The expense, delays and annoyance occasioned by hot driving boxes with oil waste cellars caused many roads to adopt grease because with the latter, the above-mentioned spring arrangement could be used, insuring the grease being held against the journal at all times as long as there was grease in the cellar. Engine or car oil will stand any pressure met with in locomotive bearing in addition to the slightly excess pressure administered under force feed.

Ordinary engine or car oil will easily stand the 400 lbs. pressure per square in. mentioned. The actual bearing pressure on M. C. B. 5½-in. x 10-in. journals is 427 lbs. per sq. in., and there are many of these journals throughout the country running perfectly cool. The oil used with the McCord system of lubrication on locomotive bearings is the usual engine or car oil used by all railroads. It does not receive any special treatment. With the bearing floating on the journal this oil will not escape at the bottom unless the feed of oil to this journal is too great. In that case the momentum of the oil revolving on the journal and with it will overcome the skin tension of the oil, and the oil will be thrown off of the journal. The feed should be cut down gradually until no oil is thrown off.

The thicker the film of oil that is maintained between the bearings and the journals, the less will be the internal friction of the locomotive, and it is the aim of the McCord system of lubrication to maintain this film just as thick as the skin tension of oil will permit.

The cost of lubrication per thousand miles per driving box with this system is about 6 2/3c., figuring the oil at 25c. per gallon. As to the life of driving box brasses with this system, the first 3-cylinder engine on an Eastern road, equipped throughout with McCord lubricators, was shopped last January after running 155,000 miles, and there was not enough journal or brass wear to necessitate dropping the wheels. The journals and brasses have not been touched since the engine was built, and it is not an easy matter to say how much more mileage can be made before it will be necessary to bore the brasses.

We are very glad to note that the article in your April issue has started this discussion, and if there are any further questions raised, we believe we have records and data enough to answer them.

McCord & Co.,
Per R. L. McIntosh.

Chicago, Ill., May 8, 1912.

An Excellent New Flooring.

A very troublesome problem for many railway mechanical officials has been finding material to make suitable floors for machine shops and roundhouses. We learn from a Consular Trade Report that extensive use is being made in Germany of a flooring composition consisting of a solution of chloride of magnesium to which pulverized magnesium added together with considerable proportions of sawdust and which being skilfully compounded provides an inexpensive and fireproof flooring.

Those familiar with the flooring say that there is neither expansion nor contraction of the material from any cause whatever after a flooring of magnesium chloride is once laid. The very ingredients are such that there is no buckling or cracking due to heat or cold. In Hamburg the composition is mixed and spread where the building operations are being carried on, the prepared dry meal being delivered in bags from the factory and the lye water made on the spot. It is impossible to state the precise rule for the composition of the meal or for the lye solution, these being the manufacturer's secrets and each manufacturer claiming particular merits for his own formula. These formulas are not patented, and there is no doubt that they are all substantially alike. Several manufacturers have expressed a willingness to sell their process, either for the whole of the United States or for restricted territory.

One Hamburg manufacturer, who uses a light coating of the material, claims for his own composition that it is crack free under all circumstances, warm under foot, elastic, and sound proof, preferable to linoleum, as linoleum curls at the edges after a time, breaks or wears away, and absorbs water, permitting it to leak through.

Improved Fuel Burning Process.

The coal strike in the British Isles led to very persistent efforts to find substitutes for coal that in some cases are likely to prove successful, but it also directed attention to the combustion of inferior coal that is likely to have a far reaching effect on the permanent demand for coal.

Some interesting experiments with inferior coal are reported from Hull, England. In connection with some water tube boilers slack coal was successfully burned of a quality formerly considered worthless. The process followed was to mix pulverized coal with oxygen in the proper combining proportions. The system is advocated as something new, although it is as old as steam boiler use.

To Restore Rubber.

People using articles made of rubber that frequently lose their elasticity through oxidation may restore the material to its original condition by a simple process. Soak the part in a mixture of one part of ammonia to two parts water. This is particularly well adapted to the restoring of rubber bands, rings and small tubing which are ready to become dry and brittle.

The Canadian Pacific has ordered twenty-five consolidation locomotives from the American Locomotive Company. The total weight in working order will be 220,000 lbs.

Questions Answered

PISTON GROANING.

173. R. M. L., St. Louis, writes: I have been assigned lately to an engine that gives much annoyance from the piston's groaning. I have had the cylinders examined several times, and there is no sign of cutting, although the groaning sometimes vibrates the whole engine. Could you kindly suggest a remedy? A.—We have been repeatedly through that groaning trouble, and have always found a charge of dry Dixon graphite injected into the cylinders an efficient remedy. You can permit small charges of the graphite to be drawn in through the relief valves.

CENTERS AND LINKS.

174. J. L. D., Santa Rita, New Mex., asks: (1) Is there a tipping point to a locomotive, and if so what is it reckoned from? (2) Why are valve motion links curved? (3) What is meant by center line of motion?—A. (1) The point at which a locomotive or other body would fall over occurs when the center of gravity falls outside of the base. The base of a locomotive is the distance between the two points where the wheels touch the rails. The center of gravity may be found by dropping a line from the upper center of a body in the direction of the center of the earth, as in the case of a weight suspended by a string. Several locomotives fell over during the earthquake in California, the undulations of the earth causing the center of gravity to fall outside of the rails. (2) Links are curved to suit the arc described by the eccentric rod, which being fixed at the eccentric end necessarily moves in a circular or curved path at the other end. (3) The center line of motion on a locomotive is a line drawn along the center of the cylinder, and is usually exactly towards the center of the driving axle, but in some of the older classes of locomotives this was not always the case, as in elevating the front of the cylinders the center line of motion would fall below the centers of the axles. It may be added that there are very few locomotives of this kind now in use. They were very unsteady in their motion.

FITTING ECCENTRIC STRAPS.

175. F. W. J., Mason, Nev., writes: There is a difference of opinion among some of the leading men in the machine shop here in regard to fitting eccentric straps. Some claim that there should be a clearance of 1/16 in., all round, others claim that no clearance is necessary. Which are right? I cannot recall seeing anything in Railway and Locomotive Engineering in regard to this matter.—A. Both views are extreme. It is good practice to allow a thickness of thin tin. An exact fit would have a tendency to heating until some clearance was made by friction. There is no fixed rule in regard to the matter, but it is safe to assume that some clearance is necessary, and the larger the eccentric, the greater the amount of clearance should be, but 1/32 in. should be sufficient under any condition. The practice varies in different railroad shops.

LOCATION OF CAB AND ENGINE SPEED.

176. R. J., Walkerville, Ont., writes: (1) Please answer through your journal why the cabs on engines running out of Niagara Falls and Buffalo have the cabs on the middle of the boilers. (2) On a run of 130 miles with 44 stops there is an engine with 17 ins. by 24 ins. cylinders; wheels, 5 ft. 6 ins. in diameter; boiler pressure 140 lbs. This engine is a little slow. Would ⅛-in. lead be an advantage? —A. (1) Cabs are so placed on locomotives that are equipped with the Wootten boiler, which extends over the frames, and does admit of the cab being placed at the back end of the boiler. (2) The amount of lead or valve opening is a matter carefully calculated by the constructor, and should not be changed. If the engine is equipped with the Stephenson valve gear the tendency of the valve opening to increase at one end of the stroke and diminish at the other is very great, and the valve gearing should be occasionally examined by a skilled mechanic. It should never be experimented with outside of the repair shop for the reason that it is not possible to determine the effect of changes made under such conditions.

GRADUATING RELEASE.

177. J. L. L. D., Santa Rita, N. M., writes: How are air brakes graduated off?—A.. With the graduated release type of brakes, such as the L. N. and P. C., the brake cylinder pressure is obtained by a movement of the brake valve to application position, is retained by a return to lap position and is graduated from the brake cylinders when desired by movements between lap and running or lap and driver brake holding positions, depending upon the effect desired.

The locomotive brake, whether E. T. or L. T., New York, can be graduated off by movements between either release, running or driver brake holding and lap positions of the automatic brake valve while the independent brake valve or straight air valve can be used to graduate the locomotive brakes either on or off regardless as to the position of the automatic brake valve.

The car brakes, however, are graduated off by alternately admitting and cutting off the flow of pressure to the brake pipe and these graduations in release can be made up to a point where the car brake pressures are nearly equalized.

COMPOUNDING AIR PUMPS.

178. L. E. C. Piedmont, Kan., writes: In your April number I notice the question No. 159, and the answer, will you please explain how this pressure of 175 or 180 lbs. can be obtained with 100 lbs. steam pressure, and how can you estimate the terminal pressure without an indicator?—A. By using the first pump to deliver compressed air to the receiving valves of a second pump, the second pump instead of compressing air on one side of the air piston, with atmospheric pressure on the opposite side, receives from the first pump compressed air which is capable of doing work or if 100 lbs. steam pressure results in the delivery of air pressure at 90 lbs. from the first pump, the force driving the piston of the second pump would be 100 lbs. steam pressure and 90 lbs. air pressure.

To find the final pressure it is proper to use an air gage, but squaring the area of the steam and air cylinders and multiplying by the pressures per square inch will give you the theoretical capacity of the arrangement from which you may deduct a certain per cent. of loss due to friction, leakage, etc.

UNDESIRED QUICK ACTION.

179. W. T. H., Angelica, N. Y., writes: An engineer handling a long train of cars with a locomotive using the New York B 3 equipment moves the pressure controller to the 90 lb. adjustment in order to hasten the release and recharge of brakes and about one or two minutes afterward turns the controller back to the 70 lb. position, whereupon quick action takes place, parting the train. Could the act of changing the adjustment cause the quick action?—A. This interference with the regulation of brake pipe pressure can contribute to the undesired quick action of the brakes by overcharging the brake pipe and auxiliary reservoirs on the head end of the train to such an extent and at such a time that when the controller adjustment is lowered the brake pipe supply is cut off and the rear auxiliary reservoirs absorb the brake pipe pressure at a rate that causes a brake pipe reduction rapid enough to cause undesired quick action on the head cars in the train.

It is obvious that brake pipe leakage, especially at the head end of the train, would assist in causing this undesirable effect, and regardless as to the desirability of excess pressure or a driving head with which to release and recharge brakes, a sacrifice in time of recharge is sometimes necessary to secure more uniformity in recharge and on long modern freight trains is absolutely essential to successful train handling.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances.

Published Monthly by

ANGUS SINCLAIR CO.

114 Liberty Street, New York.

Telephone, 746 Rector.

Cable Address, "Locong," N. Y.
Glasgow, "Locoauto."

Business Department:

ANGUS SINCLAIR, D. E., Prest. and Treas.
JAMES KENNEDY, Vice-Prest.
HARRY A. KENNEY, Secy. and Gen. Mgr.

Editorial Department:

ANGUS SINCLAIR, D. E., Editor.
JAMES KENNEDY, Managing Editor.
ALLEN G. WOOD, Consulting Engineer.
GEO. W. KIEHM, Associate Editor.
A. J. MANSON, Associate Editor.

Boston Representative:

S. I. CARPENTER, 643 Old South Building, Boston, Mass.

London Representative:

THE LOCOMOTIVE PUBLISHING CO., Ltd., 3 Amen Corner, Paternoster Row, London, E.C.

Glasgow Representative:

A. F. SINCLAIR, 15 Manor Road, Bellahouston, Glasgow.

SUBSCRIPTION PRICE

$2.00 *per year,* $1.00 *for six months, postage paid in the United States, Canada and Mexico. For other parts of the world,* $2.50, *or ten shillings. Single copies,* 20 *cents. Remit by Express Money Order, Draft, Post Office Order or Registered Letter.*

Mailing address can be changed as often as necessary—always give old and new address, and if you subscribe in a club, state the name of the agent.

Please give prompt notice when your paper fails to reach you regularly.

Entered at the Post Office, New York, as Second-class Mail Matter.

The Railway Master Mechanics' Convention.

For several years complaints have been heard at every convention of the Railway Master Mechanics' Association, that the number of subjects to be reported upon has been too numerous to permit of time for discussion. The reports submitted very rarely represent the ideas of and information possessed by more than a small percentage of the members, for the reason that very few of them answer the circulars of inquiry in a way that would represent full current knowledge; but when a free discussion follows the reading of a report the members readily tell what they know and thereby much valuable information is brought out that otherwise would be lost. There is small prospects of full discussion of reports being heard this year, for there are no less than sixteen reports to be read, the largest number ever submitted to one convention. None of the subjects is of a character to excite much discussion, but all of them take time, and there is the old-time danger that on the last day a mass of important business will be hurried through because there is no time to give it the deliberate attention it deserves.

Where there is much detail of business at conventions, there is much loss of time through dilatory motions and through delay in having members promptly make and second motions; that is, the conduct of routine business takes too much time. As a remedy for this loss of time we would recommend the adoption of a practice adopted by President Gardner at a meeting of the Railway Guild. A report having been read the president said: "Gentlemen, you have heard the report. Mr. H. U. Mudge will move its adoption, and Mr. C. W. Huntington will second the motion." That was done, and as the two gentlemen named were physically the largest men in the meeting, no frivolous objections were raised. In adopting similar policy, if President Bentley, for instance, should say: "Gentlemen, you have the report. Mr. D. R. MacBain will move its adoption and Mr. G. W. Wilden will second the motion," and so on throughout the whole of the proceedings, a great deal of time would be saved that usually is lost.

In looking over a list of subjects that are to be presented for discussion, it is always difficult beforehand to select those that ought to receive the most serious consideration. From what we have seen of current railway practice we are inclined to think that the subject, Maintenance of Superheater Locomotives, would yield as much desirable information as any subject on the long list. We are not aware what experience the chairman of the committee, Mr. R. D. Smith, has enjoyed with steam superheaters, but we feel sure that he has spared no labor in collecting facts. The steam superheater appears to be growing in popularity, but there are many railroads still waiting for light before investing in this form of locomotive improvement, and no doubt some of them look forward to this report for giving a supply of reliable superheater guidance.

Next in importance among reports we consider mechanical stokers. That subject may be considered of a perennial character, for the important question has been up for several years, but knowledge concerning the value of mechanical stokers has not been by any means exhaustive. Mr. J. Rumney, chairman of the committee, has taken great practical interest in the subject and probably knows more about mechanical stokers than any member of the association. The subject deals with growing mechanism that every year becomes more firmly developed, and the association can depend upon the most advanced progress of the art being placed before them by Mr. Rumney. Within the last year we have heard remarks made to the effect that the general introduction of steam superheaters will reduce the fireman's work to such an extent that mechanical stokers will no longer be necessary, but we regard that as a mistaken view, for the increasing capacity of locomotives is likely to hold good the necessity of doing the heavy drudgery of firing by mechanical means.

Design Construction and Maintenance of Locomotive Boilers is a very important subject and one that will bear protracted discussion which it is likely to receive, for every member knows something about boilers. Mr. D. R. MacBain, chairman of the committee, has devoted special attention to locomotive boilers and is certain to submit facts that will bring out new information and excite discussion. There are two novel forms of locomotive boilers that have been used by railroads during the last year, and it is to be hoped that detailed information concerning them will be submitted by some of the members.

There are two reports due relating to tires—one on Contour of Tires, of which Mr. W. C. A. Henry is chairman, and one on Steel Tires, with Mr. L. R. Johnson as chairman. We do not think that either of these subjects is likely to excite much discussion. We think the purpose of the Committee on Contour of Tires is to do something towards making locomotive tires conform to the practice of the Master Car Builders' Association with car wheels. Some railway people make their locomotive tire treads slightly conical, while others make them straight or cylindrical. If uniformity is arrived at in this particular, something will be gained. We notice that most of the members of this committee are in charge of shops, so it is likely that their views on the contour of tires most easily finished and maintained is desired. What the committee on steel tires is expected to investigate is not very apparent, for there has been no conspicuous complaints concerning failures of steel tires as there has been about steel rails, but Colonel Johnson may be depended on to do justice to the subject whatever line of investigation he may be required to carry out.

Main and Side Rods is a subject of investigation in charge of Mr. W. F. Kiesler, Jr. The members of this committee are mostly mechanical engineers, from which we infer that the investigation will turn on the best form of these rods to combine lightness with strength. It seems to us that such an investigation is badly needed when we look at the huge rods that are now common on heavy locomotives. American practice in this respect differs greatly from European practice, where rods are much lighter than ours, yet give no conspicuous trouble with breakage so far as yet reported.

A somewhat important subject is Specifications for Cast Steel Locomotive, of which Mr. C. B. Young is chairman. To decide on the most suitable elements to make cast-steel frames sufficiently strong for the terrific strains they are required to withstand, is the duty of a metallurgist, and all the convention can do is to endorse his or their selection.

The remaining subjects are not likely to excite much discussion, although some of them are important. They are: Consolidation, with Mr. D. F. Crawford chairman; Safety Valves, Mr. W. J. Tollerton, chairman; Safety Appliances Mr. H. T. Bentley, chairman; Flange Lubrication, Mr. M. H. Haig, chairman; Minimum Requirements of Headlights, Mr. D. F. Crawford, chairman; Standardization of Tin Ware, Mr. A. J. Poole, chairman; and finally Arrangements, Mr. H. T. Bentley, chairman. To get through all that volume of work will require hustling. Our advice to President Bentley is, begin early and permit the pressure of business to be felt the first day. It is always in evidence on the closing day.

Instruction Cards.

The recent introduction of scientific management as applied to railroad work has given an impetus to the system of better instructions in regard to the details of mechanical construction and repair. The system is not new, but its wider use is a step in the right direction. At first there was a tendency among the workmen themselves to belittle the importance of the scheme. Experienced mechanics are very apt to think that they know it all, but even specialists may learn something new if their minds are open for information. The growing use of high speed steel has revolutionized many mechanical operations, and the end is not yet. It is readily noted that in different shops there are different methods of doing even the simplest things, and surely, it is wise to adopt the best. Any method leading to a system of driving men and machinery beyond their proper and natural speed is wrong in general, wrong in particular and wrong in detail. To adopt new and better methods of work is altogether to be commended.

Some of the leading railroads have adopted a system of encouraging the workman to suggest improvements, and prizes are awarded to those whose ingenuity meets the approval of the heads of departments. By this means a spirit of friendly rivalry is maintained that cannot do other than add to the general good. In our own experience we have seen supercilious individuals in charge of better men than themselves, and any suggestions looking to improved methods was not welcomed. Fortunately this spirit is fading away, and it is high time, and no small credit is due to an enlightened press. The reading mechanic or head of department is always the best. It is to be regretted that more mechanics do not write of their occupations and experiences. This defect is also owing to the lack of encouragement, but even this also shows improvement. Our correspondence department is an excellent proof that many mechanics can write and write well, and we have done all that we can to cultivate this fine quality among the more thoughtful and accomplished railway men.

Such correspondence will always be welcomed by us. In addition to the spreading of valuable information many of our correspondents make a handsome sum in this way and new contributions are always cordially welcomed. The time when flowers were born to blush unseen and waste their fragrance on the desert air is past. This is neither an age nor a country where any man or any set of men should hide their candles under a bushel. We feel and know that we are doing our part and the warm approval that has come to us from the highest to the humblest of railroad men induces us to cherish the hope that we may long continue to go on in the way that we have done, and every new thought that comes to us will be welcomed and cherished.

Back Pressure and Compression.

When one listens to mechanics and engineers discussing the working of the steam engine, the fact becomes apparent that the knowledge concerning back cylinder pressure and compression is very inexact. It is also perfectly plain from the arguments used by many mechanical writers that compression and back pressure are confounded by them as being one and the same thing. To make a clear distinction, back pressure is caused by the steam or gas left in the cylinder after the exhaust opens, and opposes the movement of the piston during the return stroke, thereby reducing the effective work done by the piston through the action of live steam on the live steam side. So long as the exhaust port is open to the cylinder, during the return stroke, the only obstacle to the movement of the piston in that direction is back pressure. When the exhaust port is closed compression begins and the vapor left in the cylinder is squeezed into the small space that finishes the strokes.

Compression gives back to the piston as much power on the return stroke as was exerted in producing it. As all pressure on the crank pins while the piston is within 2 ins. of the end of the stroke only produces extra friction and does no useful work, compression is useful in helping to equalize this pressure in arresting the moving parts. It also supplements the effect of leading opening by filing the clearance space with a pressure nearly equal to the steam chest pressure, and it also tends to heat the cylinder metal, thereby preventing loss from cylinder condensation. As action and reaction are equal, the compressed steam will give out in effective work as much power as was taken to produce it, less the friction, which is probably more than paid for by the saving of heat already mentioned.

Unless compression produces a greater pressure than that in the steam chest, it is advantageous and necessary, especially at high speed when the reciprocating parts demand a strong cushion. The difficulty with people who have invented valve motions that would eliminate compression has generally been that they confounded compression with back pressure and tried to produce a motion that would do away with both. The reduction of back pressure tends to save steam; but the elimination of compression has the opposite effect.

The writer at two different times was invited to make tests of locomotives having what was called improved valve motions. In both cases the engines were tried against others having the link motion, and in both cases the link motion engines did the work with less consumption of coal than the others. From the indicator cards taken, the writer felt assurred that the engines having the improved motion were using less steam than the link motion engines; but more coal and more water were used in doing the work. The explanation that came through severe mental process was, that compression being almost eliminated, the cylinder had to be filled by live steam and the absence of the heating process resulting from compression caused cylinder condensation that was not demonstrated by the indicator diagram.

Local Terms.

It is amusing to notice the airy way that American merchants, quoting prices to foreign customers, use terms that are never used outside the United States. An American merchant having been ambitious to secure trade in China offered hams at so much a car load. The query came back: How many pounds are a car load? It is surprising how thinly common sense is spread in some transactions.

In ancient times American manufacturers were accused of selling artificial nutmegs and other things meant to deceive. That line of industry now appears to have moved to the Orient and is promoted by a demand for ancient curios. Hongkong appears to be the headquarters for the sale of ancient Chinese vases and other porcelains that are all made in Europe. The "planting" of coins in the ruins of Pompeii is another flourishing industry much encouraged by traveling Americans. The coins are patterned after genuine ancient specimens.

Wanted a Standard Locomotive Front End.

A question which is frequently sent to us for an answer, especially from abroad, is: "Can you send us a blue print or a description of the American Railway Master Mechanics' Association Standard front end?" This we always fail to do for the simple reason that the association named has no standard front end.

It appears to be very strange that the Master Mechanics' Association has not established a standard front end because the subject of investigating the best form of front-end has received extraordinary attention. The members at the first meeting of the association discussed draft appliances, and the subject has been ventilated in some form at nearly every convention since that time. It has been investigated by special committees repeatedly, and Professor Goss was engaged for several years experimenting with different forms and combinations of draft appliances on the locomotive experimental plant at Purdue University. Extensive experiments were also carried out on the Chicago Northwestern stationary plant by Mr. Robert Quayie and Mr. Edwin M. Herr, and at other places by competent investigators, particulars having been reported to the association. Reports were made recommending certain forms of draft appliances, and one was selected as the best for all round purposes, but for some reason the association did not include it in their list of standards.

At the convention of 1896 an extraordinary exhaustive report on Exhaust Pipes & Steam Passages was submitted by a committee of investigation, consisting of Robert Quayle, William Forsyth, James McNaughton, William S. Morris, D. L. Barnes and Professor Goss. The work was done by different members and was outlined by the committee as follows:

First. Determine the angle of the exhaust steam jet.

Second. The effect of the shape of the orifice on the angle and shape of the jet.

Third. Determine the effect of height of bridge on the direction of the individual jet.

Fourth. Vary height of nozzle with best form of orifice and height of bridge, as determined by tests second and third. from the highest to the lowest practicable point, with the form of stock recommended by last year's committee. Indicator cards to be taken to also determine the effect of form of orifice on the back pressure in the cylinders.

Fifth. Vary the length of stack recommended by last year's committee, with nozzle located at the most efficient point as determined by the fourth test.

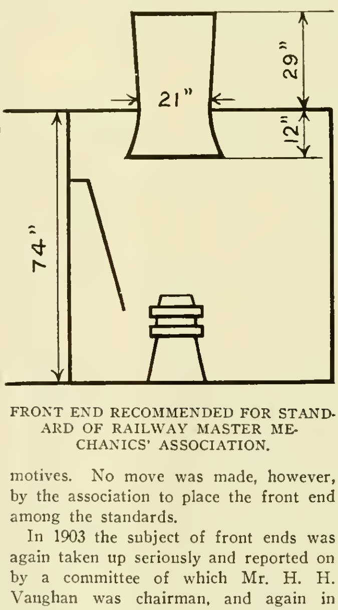
Sixth. Vary the heights of straight stock that last year's committee recommended, nozzle located same as in fifth test.

Seventh. Vary the size of the nozzle with the best arrangement of parts, as already determined.

Eighth. Comparative results of double or of single nozzles.

That work was carried out with infinite labor, exactness and skill, as the report covers 85 pages of the Annual Volume for 1896, is illustrated by 25 separate cuts and 53 page and folder plates.

A form of front end arrangement was recommended and members were requested to experiment with it and report the following year. This was done, and at the 1897 convention fifteen members related their experience with the front recommended, and they were nearly all favorable to the arrangement. Some of them obtained better results by leaving out the petticoat pipe, and others asserted that the choke was too small and ought to be made larger than the nozzle. The trend of the testimony was, however, decidedly in favor of the front end, and some of the members told that they had made it the standard for all their locomotives. No move was made, however, by the association to place the front end among the standards.



FRONT END RECOMMENDED FOR STANDARD OF RAILWAY MASTER MECHANICS' ASSOCIATION.

In 1903 the subject of front ends was again taken up seriously and reported on by a committee of which Mr. H. H. Vaughan was chairman, and again in 1906 another report on the same subject was made. Both these reports indicated that much careful experimental work had been done, especially in 1906, when all the experiments described in the report were conducted by Professors Goss and Teague on an Atlantic type engine loaned by the New York Central Railroad for use on the Purdue University experimental locomotive plant.

After careful consideration of the results obtained with different sizes and forms of stacks, exhaust pipe sizes and heights, lift pipes, inside and outside stacks of different dimensions, the committee recommended for a smoke box 74 ins. diameter, a smoke stack 29 ins. long outside the smoke box, and 12 ins. long inside. The stack is tapered and is 21 ins. at the smallest diameter, which is in line with the top of the smoke stack. There is no lift pipe. The length of the smoke box may vary from 46 to 66 ins.

The "recommended" front end could be proportioned to suit any size of locomotive, and if adapted as standard would probably save much trouble and expense to people who guess at dimensions for front end parts and produce poor steaming arrangements. The varied conditions of locomotive operation render a front end suitable for every kind of coal and all kinds of train service impracticable, but there certainly ought to be a front end capable of being modified to suit all locomotives. At the June convention a committee will report on Revision of Standards. That committee would perform a valuable service to railways all over the world if they could induce the American Railway Master Mechanics Association to make standard the front end that the committee recommended in 1906. The arrangement with or without the lift pipe is standard on several railways, and the cause of uniformity would be promoted were it made the standard of the association.

Railways Encourage Farmers.

The various State authorities, whose duty it is to encourage agriculture appear to be falling into the habit of neglecting that highly important duty and depending upon railroad magnates to promote the tillage upon which the prosperity of rural communities depends.

The State of New York has gained immensely from the labors of Mr. W. C. Brown, president of the New York Central Lines, in disseminating knowledge of scientific farming among those best able to profit from improved methods. Mr. James J. Hill is another railroad president who is striving to promote the interests of his company by helping farmers to improve their methods. He holds that the average farmer is worth one thousand dollars a year to the railroads used for shipment of his produce. The farm produce makes traffic for the railroads and that traffic makes dividends. Several lengthy reports have come to us stating that the Canadian Pacific is offering a loan of money to each farmer who will emigrate from the United States to Canada, and many are eagerly swallowing the bait. The conditions imposed are that they must have enough money to make a payment of one tenth on the land bought, and to support themselves and families for one year. The loan is added to the purchase price of the land, and is to be used for buildings, equipment and cultivation. If Mr. Hill's estimate holds good,

the railroad company is making an excellent investment.

The Northwestern and Middle States that are getting deprived of their most valuable farmers through the enterprise of the Canadian Pacific Railway, are doing nothing to restrain the drainage of their most valuable citizens. The average rural legislator never displays real vigor except when he is howling against transportation companies. Thousands of immigrants of the material from which good farmers are made land monthly in New York and drift into undesirable occupations, because the States needing their energy never beckon them to the regions where their labors would create the food supplies that are becoming scarcer every year. The farmers are afflicted with the form of jealousy that works in favor of reducing their class rather than in increasing it.

Inventor of the Mallet Compound.

Few people who are familiar with the Mallet locomotive are aware that the name comes from the inventor of the first successful compound locomotive.

Various attempts were made by inventors to produce a compound locomotive, even before the compound marine engine or compound stationary engine was made a positive success; but they were all failures, until the solution of the problem was undertaken by Anatole Mallet, a celebrated French engineer. M. Mallet was chief engineer of the Bayonne & Biarritz Railway, where, in 1876, he put two compound locomotives into operation. They were small experimental engines, but they worked so well that others followed in rapid succession.

After examining one of these engines Mr. Webb, of the London & Northwestern Railway, declared that he could design a better compound locomotive, and the result of that eminent engineer's labors was the three-cylinder compound locomotive, many of which were built, but they all proved failures when freed from the fostering care of the inventor.

The people in charge of the 1889 Paris exposition contracted with M. Mallet for locomotives to operate within the exposition grounds, on the Champ de Mars, which were very extensive. That gave the Mallet compound the publicity which soon brought it into popularity with railways having heavy grades to operate.

M. Mallet translated into French a pamphlet on compound locomotives, written by Angus Sinclair as a contribution to the New England Railroad Club, and it was largely circulated in European countries.

Locomotive Preferred to Multiple Unit Motor Cars.

A question of considerable importance to the railway engineering world has recently been decided by the officials of the Prussian Government Railways. The decision had been arrived at to operate the intricate system of Berlin city railways with electricity instead of steam, and the question arose whether to use multiple unit motor car trains or trains hauled by electric locomotives.

When all the pros and cons had been exhausted, a decision was made favoring electric locomotives. The reasons given for favoring electric locomotives were: they are less damaging to the track than electric motor cars, and one of them can take the place of many motor cars, as the limit has practically been reached in the size of motor which can be hung under the floor of a motor car between the driving wheels. The cost of maintenance of electric locomotives is proportionately smaller than that of motor cars, and the electrical equipment is well protected and easily accessible. The amount of electric energy consumed will, under similar conditions, be less with them than with motor cars, as the efficiency of the large locomotive motors is higher than that of the more numerous and smaller motors necessary with motor cars. The total weight of the electric motor is spring-borne in the case of the locomotive, which is not possible in the case of motor cars, and there is no noise or vibration on the passenger coaches, caused by the motors, to inconvenience the passengers. A further important consideration is that by the employment of electric locomotives the very large amount of existing rolling stock can be used. These and other reasons have decided the question in favor of electric locomotives.

Omnipotence of Tools.

"Man is weak of himself and of small stature," says Carlyle; "he stands on a basis, at most for the flattest soled of half a square foot insecurely enough, nevertheless he can use tools, can devise tools. With these the granite mountains melt into light dust before him; he kneads glowing iron as if it were soft paste; seas are his smooth highways; wind and fire his unwearying steeds. Nowhere do you find him without tools; without tools he is nothing; with tools he is all."

When we look at a massive machine of wondrous power we seldom reflect that it is a triumph of the tool maker's art, and that the capacity to create massive engines has merely kept pace with the improvements in machine tools.

The concentration of power is more apparent in a great machine tool than it is in any product of man's skill outside of electrical appliances. The engine lathe is the highest triumph of tool construction, yet it is only a comparatively short time since the lathe was a one-man tool. Until the beginning of the nineteenth century, the lathe was operated by one man, aided by a lath secured to the ceiling, which drew up the belt and afterwards gave its name to the tool.

When outside power became applied to driving the lathe, it was found that one horse-power, or 33,000 pounds, raised one foot per minute, represented the exertions of twelve men. What a multitude of men would be required to keep in motion the machines of a modern machine shop! Man has gone beyond himself in developing machine tools that never would have worked without the concentration of power that has been worked out by the ingenuity of many men.

Preparing to Use the Panama Canal.

The apathy displayed by the maritime interests of the United States towards the opening of the Panama Canal is surprising and decidedly in contrast with the activity displayed by other countries. The steamship companies of Japan are preparing to put three steamers to trade on the western coast of South America by the Panama Canal. It is reported that the Compañia Sud-Americana de Vapores, of Valparaiso, is about to build six large steamers to ply between Chilean and United States ports via the canal, and other steamship lines are preparing to change the routing of their vessels. Commercial houses here are increasing their capacity and making new connections with American exporters, so as to be in line for the rush, and it will be well for American firms to grasp fully the situation and to avail themselves of the full benefit of this opening for American business.

Meanwhile American steamship interests appear to be hanging back for the passage of laws that will give them artificial advantages over their competitors in the use of the Panama Canal.

Automobiles Killing by Wholesale.

It used to be that the public cited in loss of life in railway accidents illustrate the small value put upon human suffering by the people of this country. The increased application of safety appliances is rapidly reducing the slaughter on railroads, but the automobile has more than made up for the fatalities averted. The number of fatal accidents that automobiles cause in the streets of New York city alone is pitiful and outrageous, and the aldermen have done nothing to check the slaughter. In 1910, 73 people were slaughtered by automobiles in the streets of New York, and in 1911 the fatalities rose to 125. During the first four months of this year 58 persons have been killed in the same city by automobiles, so that the slaughter promised for the year will be 174.

In some towns ordinances call for railway train speed being reduced to 20 miles an hour. In New York it is quite common to see automobiles running over thirty miles an hour.

Railway Signaling

The importance of railway signaling is such that it not only becomes every railroad employee to make himself familiar with the most recent improvements in the department, but he should also be instructed in the development of railway signaling. Among the means that are placed within the reach of railway men to familiarize themselves with the details of the working of the various departments, it is gratifying to observe the growth of educational facilities furnished by the leading railroad companies. Not only are apprentices better provided with opportunities for obtaining a thorough knowledge of their calling, but those who are of more mature experience in any department are also furnished with educational facilities, so that it may be truly said that it is within the reach of every active, intelligent man, who desires to do so, to become familiar with the details of all railroad work.

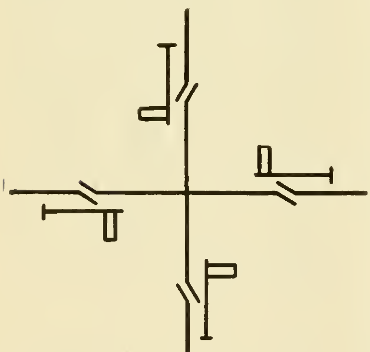


FIG. 1

Railway and Locomotive Engineering, since its inception has been foremost in the good work of aiding in the better education of railway men, and it is a matter of pride and satisfaction to us to feel and to know that our work has been appreciated. What we have already done is but an earnest of what we hope to do, and it occurs to us that amid other work, that of signaling has not been as prominently brought to the attention of the railroad employees generally as it might be, but there is a growing desire on their part to become better acquainted with this important branch, and the signal engineers have shown a praiseworthy readiness in the educational work. Mr. Thomas S. Stevens, signal engineer of the Santa Fe System, has presented the subject to the employees of that road in a concise and interesting way in the pages of the Santa Fe Employees' Magazine, and we take pleasure in presenting in our pages a condensed epitome of his excellent series of papers on the subject.

In introducing the subject it may be stated that there are several purposes for which signals can be used: Interlocking, spacing trains, delivery of orders, protection of trains against possible obstructions, such as misplaced hand switches, and so forth.

Here it should be noted that all may be classed under the general head of

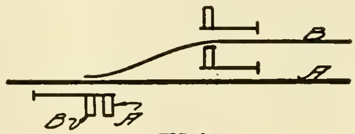


FIG. 2

"Protection against obstructions to the free passage of a train." Under any of the different heads conditions may arise which render it unsafe for a train to proceed.

With interlocking it may be that switches are not in the right position and properly locked for a particular train. Derails may be open or some other train may be using the track over which the train must pass. All are obstructions. When signals are used for spacing trains it is easy to see that a train occupying the track over which the train should run becomes an "obstruction." When signals are used at order stations there is a necessity, and often a grave one, for trains to stop and get orders, and in this case the orders are the "obstructions," regardless of the fact that, when delivered, they may assist the train. The "obstructions" caused by misplaced switches, etc., are understood easily, so that the first general assumption can be formulated that: Signals are used to indicate when it is necessary for trains to stop because obstructions exist. A signal indicating "stop" is in itself an obstruction at which trains must stop, but not before reaching it. A switch properly set for a siding is an obstruction to the

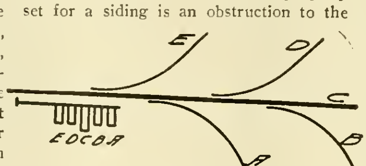


FIG. 3

passage of trains which must pass along the main line, but not to a train which is to enter the siding. The first train must stop at the switch and set it for the main line. The second may have to limit its speed in order to enter the siding safely. So there exists a class of obstructions which do not necessitate stopping trains at a distance from them, but which do necessitate that trains shall stop before reaching them. If these obstructions are situated so that they cannot be seen readily, it is necessary to limit the speed of the train to a point at which it can be stopped if necessary when the engineman sees the obstruction. The second general assumption now can be formulated that: Signals are used to indicate that the speed of the train must not exceed that at which the engineman can stop safely whenever necessity arises. This is called a caution indication, and the well-known explanation. "Ability to stop within the limits of vision."

We now have seen that signals are used for two purposes: To stop trains and to limit their speed. These are the only two purposes for which signals are required, but, whenever it is necessary to erect a signal for either one of these purposes, means must be provided to indicate to trains that there is no necessity, in so far as the signal is concerned, to stop or limit the speed of the train. For this purpose the convenient indication, "Proceed," has been provided. So there are three indications which can be given to

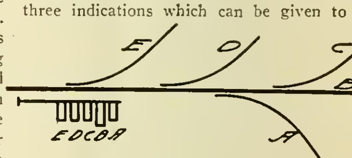


FIG. 4

enginemen by signals: First: You must stop your train—"Stop!" Second: You must limit the speed of your train—"Caution!" Third: You need neither stop nor limit the speed of your train so far as this signal is concerned—"Proceed!"

In the past it has been deemed good practice to signal over different routes at interlocking plants by means of several arms grouped on the same mast. Regardless of this the indications are the same. When two routes, "A" and "B," Figure 2, exist, and two arms are used. one arm indicates "Stop," "Caution" or "Proceed" on route "A," while the other gives the same indication for route "B."

Although the full argument will be presented later, it should be noted here that, if route "A" is the main line and route "B" is a branch, the speed of the train must be limited when moving onto route "B" and therefore the indication given by the lower arm becomes an indication limiting the speed of the train and is in reality a caution indication.

The interlocking purpose was placed first on the list because this phase of sig-

naling has had the greatest development. At first interlockings were simple. It was deemed expedient to protect a railroad crossing at grade with derails, as in Figure 1, or to handle a junction switch from a tower, as in Figure 2, so that trains need not stop to handle the switch.

In these the signaling also is simple, as the maximum number of arms used on the same mast is two. The enginemen very easily could learn the different routes to which arms "A" and "B" were assigned. Situations became more complicated later and the problem confronting the signalmen was how to arrange the arms on the mast so that it would be easy for the engineman to remember to which route they referred. The first thought was to signal over the first turn out to the right with the top arm, and so on down the mast to the main line, then the first turn out to the left, and so on.

Figures 3 and 4 illustrate this style of signaling, known as route signaling. It will be noted that there are the same number of routes in each, but that they are distributed differently.

In Figure 3, C is the main line, D is a branch and A, B and E are sidings.

In Figure 4, B is the main line, D is a branch and A, C and E are sidings.

This way of assigning the arms was

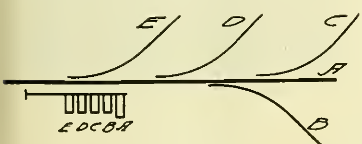


FIG. 5

logical and easy for the men to remember, but it will be noted that the main line arm is third on the mast in Figure 3, while it is second in Figure 4. It readily can be understood how difficult it must have been for the main line high speed man to remember the combinations he must see before he knew that it was safe for him to proceed at speed, particularly when it is understood that the number of arms might differ as well as the combinations of the arms. In some instances an effort was made to distinguish the main line arm by making it longer than the rest, but this did not help the men on dark nights. At these times it always was necessary for the main line high speed man to know the exact combination of lights which should be displayed at each location.

It did not take long to realize that something must be done to simplify the situation for the high speed man, and the first thing done was always to place the signal for the main line at the top of the mast, as in Figure 5. Several different methods of assigning the rest of the arms to different routes were tried.

All were more or less unsatisfactory, and it was so difficult for the men to remember the different combinations of lights that finally all the arms but two were abandoned, and if there were more than two routes an indicator was provided to show what route was signaled over (Figure 6).

When the lower arm indicated proceed the indicator showed whether route B, C, D or E was signaled over, by the display of a letter. It became necessary for the men to know to what route this

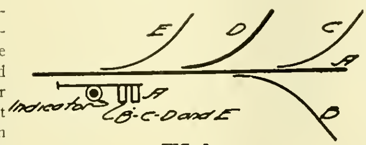


FIG. 6

letter referred, and it soon developed that they proceeded under any indicator if the lower arm indicated proceed. For this reason the indicator eventually was abandoned and a simple two-arm signal (Figure 7) came into use. The top arm signaled over the main line and the bottom arm over all other routes.

Now let us see what we have done. There is no longer any information about routes to be obtained from the signal except with reference to the main line, because there are four routes grouped together on the lower arm. The lower arm gives a limiting speed indication (a caution indication) and the top arm, because it signals over the main line over which the highest speeds are possible, can without difficulty be understood to give a high or unlimited speed indication.

This was the thought, then, which was introduced into signaling just before the discussion in the associations took place—that signals should be used to indicate speeds and not routes.

In some instances it was found that accidents occurred once in a while due to all but main line routes being grouped on the lower arm. This was supposed to be due to the fact that an engineman

FIG. 7

might arrive at a signal and be allowed ordinarily to proceed over a route which permitted of a fairly high rate of speed, such as into a very long passing track or into a yard lead. Some day the towerman might give him a route into a short siding and, if he maintained the same speed he had been accustomed to maintain in a long track, there might be trouble. This was not a true conception, because the men should control their trains safely, but it led to a slight addition, as shown in Figure 8, and many roads adopted a three-arm signal or a two-arm signal with a dwarf signal at the foot of the main mast as the standard whenever the number of routes required.

Before leaving this part of the subject it will be well to draw attention to one fact: Every railroad on which a fair amount of business is handled at a fairly high rate of speed is provided with route indicators in the shape of switchlights before any signaling is done. A switch target or light cannot be treated as a stop or proceed signal, because the different lights and targets mean entirely different things to different trains. A green light, for instance, at a junction, is a proceed signal for the main line man, but a stop signal for the branch train, and similarly the red light becomes a stop or proceed signal, dependent upon the train approaching. The switch target or light is a route indicator. This, so far as the interlocking purpose is concerned, completes past history and brings us to the association discussion.

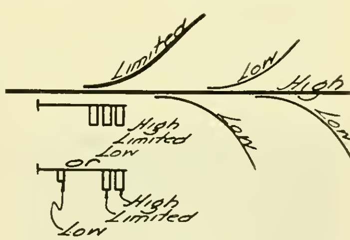


FIG 8

Wireless Train Control.

Mr. Frank W. Prentice, the inventor of the wireless system of train control gave an interesting demonstration before the Central Railway Club at the Hotel Statler, Buffalo, N. Y., last month. The demonstration created the liveliest interest among the members and guests, and the general impression among the large body of railway men present was of the most favorable kind. As was described in the March issue of Railway and Locomotive Engineering, the method of installation of the wireless control is to divide a stretch of track into blocks varying in length from 2,500 feet to 4,500 feet. At the end of each block is a generator of wireless waves. A broken rail or open switch will stop the generator, thus placing the block in the rear at danger by the absence of the wave. The full details of the important invention were described by Mr. Prentice, and many questions in regard to its application were answered. Costs of intallation and maintenance based on lengthened experiments on the Canadian Pacific, and which are remarkably small, were also given.

Air Brake Department

Air Brake Convention.

The Hotel Jefferson at Richmond, Va., was selected as the meeting place of the nineteenth annual convention of the Air Brake Association, which was called to order Tuesday, May 7, by the presiding officer, Mr. W. P. Huntley.

After the opening prayer by the Rev. Geo. W. McDaniel the members were welcomed by His Excellency W. H. Mann, Governor of the State of Virginia, whose addresses consisted of well-chosen and somewhat humorous remarks, bearing upon the history of Virginia, ending in a vein of patriotic sentiment.

Mr. M. J. Capples, fourth vice-president of the C. & O. Ry., spoke from the standpoint of an operating official of the railroads and expressed his pleasure in public recognition of the work of the Air Brake Association.

A representative of the Mayor of the city and the President of the Richmond Chamber of Commerce also made brief addresses of welcome, after which the presentation and reading of papers on technical subjects was taken up.

W. P. HUNTLEY,
Ex-President, A. B. Ass'n.

It is not our purpose at this time to dwell at length upon the papers presented, as the information contained in them will be placed before our readers in future articles which will appear as the "Empty and Load Brake," the "Electro Pneumatic" and other apparatus is described.

Due to the gentlemanly manner and courteous consideration of the presiding officer, the business of the association was transacted without the slightest indication of friction or antagonism between the members, which is frequently the outcome of differences of opinion when expressed before a large assembly.

In fact, the attitude of the chair was at all times such as to inspire a discussion entirely free from criticism or sarcastic comment with the net result of the most interesting, profitable and business-like session that has been held in recent years.

The first paper was "The Job Behind the Cleaning Date," by Mr. C. P. McGinniss, which was of a very practical nature, dealing with the work of repairing and care of freight car brakes under adverse as well as favorable conditions, and was illustrated by photographs.

It contained recommendations for betterments in conditions which were being followed by the road with which Mr. McGinniss is connected, and the discussion which followed the reading of the paper brought forth points of information valuable to the air brake repairmen.

The afternoon session consisted of a lecture on the "Empty and Load Brake" for freight cars, by Mr. W. V. Turner, chief engineer of the W. A. B. Co.

The readers of Railway and Locomotive Engineering know of Mr. Turner, but for the benefit of a considerable number of new subscribers we wish to state that a few years ago the weights of cars and locomotives increased to such an extent that quick action automatic and high-speed brakes could no longer stop trains from high rates of speed in reasonable distances and further increases in speed, weight and volume of traffic created a condition that demanded immediate relief in the form of an efficient brake.

It would not be entirely correct to say that every air brake man in the country had an opportunity to solve the problem that Mr. Turner was enabled to recognize, because we believe that there are a considerable number of railroad men who have not as yet realized a necessity for a more efficient brake.

Mr. Turner, however, solved this problem and incidentally a number of others of a complex nature by the design and perfection of such air brake equipments as the "E. T.," "L. N.," "P. C.," "Empty and Load" and the "Electro Pneumatic."

What he has accomplished while dealing with these problems can only be appreciated by air brake men, scientists and operating officials of great railroad systems, because features such as quick service, graduated release, uniform recharge and high-pressure emergency are of no particular significance to the average traveler, while the release of the last brake in a train at the same time or ahead of the first brake a safety feature evolving from a depletion of pressure or failure of mechanism as well as a brake that furnishes uniform retarding effect regardless as to whether the car is empty or loaded, has for many years been considered impossible, and those features operating through the variation of air pressure in a single piece of pipe connecting the cars, when contemplated by the scientific man is pronounced as nothing short of marvelous.

H. A. WAHLERT,
President, A. B. Ass'n.

As a result of Mr. Turner's work, the Air Brake Association recognizes him as the man qualified and entitled to say the last word on air brake subjects, and the scientists of this country recognized in him a man of remarkable genius who ranks among the greatest inventors of this, or any other, age.

Concerning the measure of a man's greatness, our readers have their own opinions as to the persons who do the most for the welfare of their country and the advancement of civilization, those whose names are continually paraded by the daily press or those who quietly follow their daily vocations solving the intricate and complex problems that are constantly arising in all branches of our country's mental and physical development.

The lecture given by Mr. Turner was illustrated with stereopticon views and touched upon the conditions which necessitated an empty and load brake while

the construction and operation of the brake was described.

Wednesday morning a paper on the subject of "Air Hose Failures," by Mr. T. W. Dow, was read, in connection therewith the care of, manufacture and test for air hose were fully discussed with the intent of determining a satisfactory hose with respect to life in service and time of removal, and it was very convincingly shown that the prevalent air hose failures are bearing directly upon the quality of hose furnished which is always in proportion to the price paid.

W. J. HATCH,
Vice-President, A. B. Ass'n.

This discussion was followed by Mr. C. C. Farmer, on the subject "Empty and Load Brake in Service," in which the performance of the brake in question and the results obtained up to the present time were commented upon by the representatives of the railroads who are using the brake, and, as wonders will never cease, a new brake equipment without an apparent fault or word of criticism, is in service.

The next paper read was "Locating and Removing Triple Valves from Freight Trains That Produce Undesired Quick Action," by Mr. J. W. Walker, of the Pennsylvania Railroad.

In connection with this subject is an introduction of a device brought out by one of the members of the association, Mr. C. L. Courson, which consists of two standard hose couplings attached to a small device containing a diaphragm, the movement of which turns a pointer on a dial and locks it in the direction which the reduction causing quick action has taken place.

Thus three or four of the simply constructed indicators can be attached in the hose couplings at various points in the train and will quickly and accurately trace up the defective triple valve or the one that goes into quick action, first without cutting the train up in portions and thereby changing the conditions that have caused the undesired quick action.

During the discussion of the paper a number of apparently mysterious cases of undesired quick action were cited and Mr. Turner, who some years ago became a practical air brake inspector and repairman through the necessity of earning a living, was called to answer the questions asked by the members. He explained the cause of, and remedy for, every case that was cited, incidentally handling the subject in a manner never before attempted. This information, which will appear in the printed proceedings of the convention, will alone justify the expenditure of the time and money of the members in attendance.

"Friction and Wear of Brake Shoes As Affected by the Wheel Load or Car Weight" was a technical and excellent paper, by Mr. R. C. Augur, which very clearly analyzed the brake-shoe problem, and the paper on "Clasp Type of Foundation Brake Gear for Heavy Passenger Equipment Cars," by Mr. T. L. Burton, is practically a solution of the brake-shoe problem.

In this connection Mr. S. W. Dudley, assistant chief engineer of the W. A. B. Co., spoke on the subject of stopping heavy passenger cars from high speeds, and set forth in detail the losses that occur through the transmission of power developed by the brake cylinder, and very clearly explained just why a very small per cent. of the original force can be converted into retarding effect, pointing out that the most efficient means yet found was at the best a poorly applied law of mechanics.

Those remarks were based upon foundation principles involving the conservation, concentration and transformation of energy which is, by the way, the most profound conception of the mechanical forces which develop in and are in effect on the earth.

At the conclusion of the subject a committee was appointed to report upon the brake shoe and foundation brake gear problem at the next convention, and there is no doubt that the investigation will prove that the P. C. equipment to develop the power and furnish the factor of safety in combination with the clasp type of foundation brake gear to distribute the available power in a manner that will reduce shoe wear and eliminate excessive increase in piston travel will permit of the construction of a most efficient type of brake shoe that will end the brake shoe problem for a number of years to come.

The paper entitled "The P. C. Equipment in Service," by Mr. T. F. Lyons, is a record of the performance of this brake to date and describes the control valve test rack and contains the code of tests for cleaned and repaired valves.

This subject was disposed of at the afternoon session of the third day, and Mr. Turner was called to the platform and informed that the association in recognition of his work and time spent with them, wished to present to him a set of resolutions, expressing their appreciation and affectionate regards.

Mr. Turner replied with a brief account of his employment with the Santa Fe R. R. and the W. A. B. Co., and the kindly sentiment of his hearers prompted him to tell of his ambition to develop the brake along Westinghouse lines.

As to when the introduction of new and complex brake equipments would cease Mr. Turner left the impression that his life's work was now nearing an end, that is, the brakes of today are efficient for any class of service, weight of vehicle or rate of speed likely to be attained for a number of years to come.

We might add that the locomotive brake problem has been solved by the E. T. brake. The freight car brake problem has confronted air brake experts for the past 12 or 15 years, becoming particularly acute with the advent of large capacity cars, and the "Empty and Load" brake answers for every requirement, while the P. C. equipment, as stated before, will provide a brake in passenger service that will be efficient for any type of cars that

W. V. TURNER,
Chief Engineer, Westinghouse A. B. Company.

are likely to be built during the next 15 or 20 years, and Mr. Turner's latest effort, the "Electro Pneumatic brake," which is now in service and will be perfected and brought to the attention of the association at the next annual convention, is, by the way, the ideal brake and, as the name suggests, the air valve mechanism is electrically operated and requires electric connection for steam road service.

During the sessions the recommended practice was subjected to the annual revision and brought up to date and discussions upon topical subjects were held,

of which there is no stenographic record.

On Friday, the last day, the paper on "Pipe and Pipe Fittings," by Mr. P. H. Donovan, was read, followed by the election of officers for the ensuing year, which are: President, Mr. H. A. Wahlert, Texas Pacific R. R.; first vice-president, Mr. W. J. Hatch, Canadian Pacific Ry; second vice-president, Mr. L. H. Albers, New York Central Lines; third vice-president, Mr. J. T. Slattery, Denver & Rio Grande Ry.; secretary, F. M. Nellis; treasurer, Otto Best. Executive committee: T. W. Dow, Erie Railroad; C. H. Weaver, Lake Shore & Michigan Southern; C. W. Martin, Pennsylvania R. R.; J. F. Barry, Ontario & Western; T. F. Lyons, Lake Shore & Michigan Southern.

The association then adjourned to meet at a place and a date to be decided upon by the executive committee, which is generally understood to be St. Louis, Mo. A telegram inviting the convention to meet in Milwaukee, Wis., was also received, and referred to the committee.

CONVENTION NOTES.

Quite a number of railroad supply companies had interesting exhibits adjacent to the convention hall, and all the products of their art were carefully inspected by the members in attendance.

There was a noticeable absence of unnecessary argument and repetition during the discussion of papers presented, which lent an air of dignity to the manner in which the association's business was conducted.

A great deal of credit is due the past president, Mr. T. L. Burton, for his experiments in connection with the clasp type of foundation brake gear. He has made some very important discoveries which will be appreciated by the railroad world during the next five years.

"To create by association a closer interest of air brake men" is an object worthy of advancement, and the association has made remarkable progress along this line; the nineteenth annual convention has set a new mark of endeavor in this direction.

Truly a remarkable gathering when Otto Best and Fred Von Bergen arrive and depart at peace with themselves and their fellow men.

Mr. J. F. Walsh, general superintendent of motive power of the Chesapeake & Ohio Railway, and Mr. C. W. Culp, superintendent of transportation of the R. F. & P. R. R., were in attendance during a portion of the second day's proceedings.

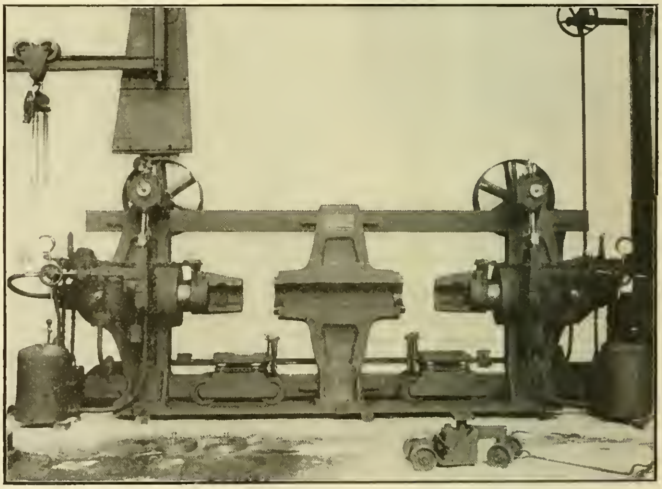
The Governor of Virginia, W. H. Mann, states that in order to earn a living he left school at the age of fourteen years and never went back; this, however, did not prevent him from becoming the president of a college. He claims for his railroad experience, the position of attorney for the Norfolk & Western R. R., which he held until he secured a better position.

One of the features of the conventions are the discussions of subjects suggested by members on the floor. The new members are invited to suggest any subject they may be particularly interested in, or to ask questions or give their experience with any phase of the air brake situation.

The Johns-Manville Co. exhibited an extensive line of their products of packings and brake cylinder expander rings. They have introduced a new composition of air pump gaskets which are said to give excellent results.

Several hundred copies of RAILWAY AND LOCOMOTIVE ENGINEERING were distributed among the members, and we were gratified to note several instances of the hotel employees reading the copies in the rooms, even if they were guilty of temporarily neglecting their duties.

We are inclined to believe that railroad officials who do not encourage their air brake foremen, repairmen and inspectors to attend these conventions are not doing everything in their power to promote the efficiency of the service.



WOOD'S DOUBLE ACTING WHEEL PRESS.

Double-Acting Wheel Press.

The process of pressing on or off car wheels has been greatly facilitated by the introduction of a new machine manufactured by R. D. Wood, 400 Chestnut street, Philadelphia, Pa. As shown in the accompanying illustration, the machine is a double-ended wheel press, and is already in very successful operation in one of the leading railroad shops.

This machine is of 300 tons capacity, and is particularly designed so that the two car wheels may be pressed on at the same time, and that two car wheels may be pressed off quickly in the same setting. The machine has two cylinders, two independent pumps and filling tanks. It is fitted with a continuous base plate and adjustable carriages on which the wheels rest when being pressed off or on. The machine is patented and is so arranged that when pressing on wheels the ram will go forward quickly to its work with air pressure, and the triplex plunger pump will force the wheels on at a maximum working speed. In forcing off wheels this machine is arranged so that the two pumps may act upon one plunger and thereby double the speed. A gauge is placed on each cylinder, so that accurate readings may be taken when wheels are being forced on.

The machine as shown is belt driven, but it can be arranged with motor drive if desired. A small hand carriage with hydraulic lift is also furnished with the machine for assembling the wheels.

A locomotive building company in Glasgow, Scotland, has under construction 52 locomotives for Australia. The cost per engine is close on $20,000.

The government of Denmark has ordered the compulsory introduction of the metric system of weights and measures. All merchants and manufacturers who neglect to weigh or measure according to the metric system are likely to be fined in amounts ranging from $2 to $30.

French capitalists are said to be interested in a plan to construct a railway across Africa that would mean a saving of nine days of the present trip from London to Bombay. The route for the projected railroad is from Tangiers to Larache, and through Abyssinia to the Red Sea.

W. V. Turner on Scientific Management.

By W. V. Turner.

When Mr. W. E. Symons' paper on the above subject was under discussion Mr. W. V. Turner, chief engineer of the Westinghouse Air Brake Company, said: "I have read over rather carefully the paper written, or read, by Mr. Symons, and I am glad to say that I am heartily in accord with the sense of the paper as I understand it. I believe that the general intention of the paper is not against economic management; that any method, call it scientific management or anything else you please, is not discredited by Mr. Symons, but issue is taken upon the saving of one million dollars a day, the inference being that the railroads of this country are so mismanaged that one million dollars a day is being thrown away, or failing to be realized, because the gentlemen in charge do not practice scientific management, and that until these scientific management gentlemen came along, thirteen or fourteen years ago, everything was being run back-end foremost or without any regard to economy.

"Mr. Symons, I think, has illustrated the point, that is, one million a day would be saved by scientific management of the mechanical department of our railroads, it would be necessary to save one of every three dollars earned per man, and, according to Mr. Vanclain's figures, I think his men only earn two dollars per day; therefore, they would have to shell out a dollar a day to the railroads to help foot the bill. That would be rather a difficult proposition, and would not only be getting something for nothing, but, on the part of the men, a case of giving something for nothing, which would reduce the pay to about the terms as those proposed by the scientific gentlemen, who have a lot of theories which, so far as my experience goes, have cost about a dollar and a half to work out for every dollar saved; this, however, is no argument against scientific management and applies only to this particular manifestation, or application of it.

"I am not actively engaged in shop management at the present time, but I am connected with a firm that has been in existence now for forty-three years and under the jurisdiction of one of the greatest men of this country. Its men are working under an economic system and are allowed to earn what they can, and there has been no strike nor symptoms of a strike in the forty-three years that the company has been in existence, and I do not think there is a stop watch in use. The men put forth their best efforts, and the result is that we have one of the best managed shops in this country, and there is no scientific management about it of the kind referred to in the paper.

"To secure such efficiency in the Westinghouse Company organization involved the expenditure of large sums of money, and it was all spent to produce the articles manufactured by our company as cheaply and efficiently as possible. The railroads have been gradually improving their facilities and educating their men, and the school systems prove this by their results; but if they were to put in such a system as is proposed by this scientific management it would be necessary to spend many more millions of dollars before the new men and methods got a start; but when the railroads are selling transportations as cheap today as they were twenty years ago they must obtain money in some way.

"When, however, they ask permission to increase rates for the purpose of getting the money essential to the development of scientific management, they are told that this money, and more, is available if they would only save it. As well explain to the newsboy, whose pockets are empty, that there is money to be made selling newspapers. A rancher out West being without ready money to scientifically develop his property, but having a timber tract, thought to raise the necessary preliminary to this scientific management by disposing of this timber. To this end, it was necessary to purchase a sawmill, and he therefore wrote to a manufacturing concern for prices, etc. They obtained information as to location and quantity, character, etc., of the timber, and quoted him a price of $10,000. This surppised Mr. Ranchman considerably, as he did not expect that scientific management would require any such initial outlay as this, and he answered the quotation by a hot wire as follows:

"'If I had $10,000, what in hades do you suppose I would want with the sawmill!' If the railroads have money enough to inaugurate scientific management, a raise of rates would not be necessary, as we are told that they would be able to add a million a day to their treasury without it. In fact, Mr. Emerson has now raised this estimate to five million dollars a day.

"Gentlemen, the worst feature about the whole proposition, as it appears to me, is the desire to get something for nothing; to inaugurate a revolution without cost; to do it by means of stop watches and bonuses (another name for premiums on bad work and concealed defects), and by the pitting of one man against another to the exhaustion of all physical and mental energies, making life a mere drudgery, with neither time nor disposition to find out that it is good to be alive.

"No one believes more in getting the best efforts out of a man than I do, but it can be done by encouraging him and giving him more enthusiasm, and should not be done by spying upon him or giving him less care or thought than the machine he is working upon. I was on the Santa Fe when this system was inaugurated, and, undoubtedly, there was room for considerable improvement, but I must confess that I am not prepared to unqualifiedly indorse the means employed to effect it or the quality of work resulting. However, we are told that these methods will in some way produce the money with which to by more machines, more locomotives, and more cars, and I supposed we ought to be satisfied.

"It reminds me of a story told on J. J. Hill. Shippers were kicking because they were not supplied witb either enough cars or as promptly as they desired, and he advised them that he would furnish cars and made preparations to issue bonds to buy cars, at which they got out an injunction tc restrain him. He turned to them and said: 'Gentlemen, if you will furnish these cars I will haul them for you,' and this illustrates pretty well about how the matter stands. No doubt Mr. Clark and Mr. Hill and another gentleman connected with our railroads would be only too glad to get out of it all that there is in it, and the fact that they desire to obtain money with which to inaugurate scientific management shows that they desire to profit from the advise and by the assistance of the efficiency engineers, but to realize it in perhaps a little different way; that is, supply the man with tools and all other things necessary to do his work, but at the same time allowing him to remain under the impression that he is still a man."

Railway Electrification in England and Russia.

There is great reluctance on the part of steam railways doing suburban business in this country to change their motive power to electricity. Much greater enterprise is displayed by steam railway companies in Europe. The London & North-Western and the South-Western Railways of England, which handles heavy urban and suburban traffic in London, have both decided to electrify their city lines, and now it is reported that the Prussian Government Railways in Berlin are about to be changed from steam locomotive traction to electric traction.

Electrical Department

The Highest Voltage Direct Current Locomotive Ever Built in the United States.

Recently the Westinghouse Electric and Manufacturing Company completed the electric locomotive shown in Fig. 1 for the Piedmont Traction Company. This locomotive is one of six which will be used in two railway systems in North and South Carolina. These systems, when completed, will comprise a total of 280 miles of track. The service will consist of limited and local passenger, express and freight. At first 35 miles will be built and electrified, using 1,500 volts direct current on the trolley, from Charlotte, N. C., to King's Mountain and will be operated by the Piedmont Traction Company; and 95 miles will be built and operated from Greenwood to Spartanburg, S. C., by the Greenville, Spartanburg & Anderson Railway, using the same voltage on the trolley.

FIG. 1. 1,500 VOLT DIRECT CURRENT LOCOMOTIVE.

The passenger and express service will be handled by multiple unit trains while the heavy freight will be handled by the locomotives. Each locomotive is capable of hauling 40 freight cars weighing 45 tons each at 20.5 miles per hour, requiring a tractive effort of approximately 13,700 lbs. It is possible to obtain a starting tractive-effort on clean dry rails of 27,000 lbs.

The locomotive weighs 55 tons and is 35 ft. over couplers. The rigid wheel base is 7 ft. 4 ins. and the total wheel base is 25 ft. There are four motors geared to the axles, two to each truck, which are fitted with wheels 37 ins. in diameter.

An interesting piece of apparatus in the locomotive is the combination dynamotor compressor which is shown by Fig. 2. This performs the function of both a dynamotor and an air compressor. The 1,500 volts direct current on the trolley is double that required for the control and lights. It is therefore necessary to reduce this voltage to at least 750 volts and this is accomplished by the dynamotor. The dynamotor is a motor with two separate windings and commutators built on the same armature core. When the dynamotor is connected to the 1,500 volts, with the two windings in series, rotation takes place and we have the same condition as if two separate 750 volt motors were connected in series to this voltage. Each winding uses 750 volts. Power for operating control and lights can thus be obtained at 750 volts by tapping between the two windings. To have the 750 volts available at all times the dynamotor must rotate continuously and advantage of this is taken to drive the air compressor for furnishing air for the operation of the switches and the brakes.

In an electric locomotive a different method is followed than in a steam locomotive, as to main reservoir pressure. Take the case of the steam air pump, this pump is operating at all times and pumps on a very slight reduction of air pressure. In other words, the main reservoir is kept at practically a constant pressure. Not so with the electric locomotive. The air compressor is driven by a motor which runs at a constant speed. The capacity of the compressor is chosen such that by operating about one-third of the time enough air is obtained for the requirements. It is not economical to run the motor at very low speed, so that instead of maintaining the main reservoir pressure constant it is allowed to vary usually over a range of 10 to 15 lbs. For instance, with 110 lbs. train line the pressure at which the compressor would stop would be, say, 140 lbs., and this would not be cut in again until the pressure had fallen, in the main reservoir, to, say, 125 lbs. The compressor is controlled by means of an electric governor which can be set for any maximum and minimum pressure, this governor opening and closing the electric circuit to the motor coupled to the compressor.

On this locomotive we are describing there is the dynamotor, running continuously, and it is only necessary to arrange the air governor so that this piece of apparatus can drive the air compressor when necessary. This is accomplished by a clutch located on the other end of the shaft of the dynamotor from that shown in Fig. 2. The clutch connects the shaft to the pinion which is in mesh with the gear enclosed by the gear case shown in the illustration.

FIG. 2. COMBINATION DYNAMOTOR COMPRESSOR.

The clutch is normally closed and held in place by a spring, so that the compressor will operate with no air pressure available. When the maximum main reservoir pressure is reached this clutch, which is an improved form of a multiple disc clutch, is disregarded

and the compressor stops. On reaching the minimum value the air in the cylinder holding the clutch open is released and the spring closes the clutch.

The methods used for lubricating the machine are ingenious and effective. Splash lubrication is used for the compressor cylinders, pinion, gear, clutch and the bearing adjacent to the clutch. The oiling is continuous. The crank case is maintained about half full of oil and the compressor cranks, in splashing through, break up the oil into small drops. Some of it is thrown through a hole in the gear case and on to the gear. The gear carries it over to the pinion which throws a portion on the clutch and a portion on the waste in a lubrication pocket over the bearing. The waste is saturated and the surplus oil drains back through a duct to the crank case.

Control for Railway Motors.

Last month we outlined the early development of the control for railway motors and described the construction of one of the modern hand controllers for series parallel connections of the motors, and pointed out and explained the important parts.

There are two general classes of modern controllers known as the "K" and "L" types. In general appearance they are the same, but it is the electrical connections and the method used for changing from series position to parallel position that makes the difference.

Electric cars are equipped with two or four motors. In starting up, the motors are connected in series with external resistance to cut down the current. This resistance is cut out step by step, and when all is cut out the car is running at one-half maximum speed, as one-half of the full voltage on the trolley is across each motor or pair of motors. To increase the speed the motors are then connected in parallel so that full voltage will be on each motor. With the "K" controller, power is not cut off when the change is made from series to parallel, but with the "L" controllers the circuit is broken long enough after full series position is reached to connect the motors in parallel. These different connections may be readily understood by referring to Fig. 3, which shows the schematic connections for the two types.

As mentioned in our previous article, all of the leads from the resistance and motors are carried to the controller, on the car platforms, and connect to the fingers. These fingers make contact with brass segments mounted on the drum of the controller, which is revolved by the handle. Different combinations of fingers are connected together and the circuit is made and broken on the fingers as the handle is notched up so that the proper connections to the motors are made. Referring to the diagram for the connections of the K controller on notch No. 1 all of the resistance is in the circuit. When the controller is moved to notch No. 2 a section of the resistance is cut out, and so on until at notch No. 5 the resistance is all cut out and the motors are running in "Series Position." Now comes the changing of motors over to the parallel position. Usually a long space is provided on the controller top with no notches marked, over which the motorman throws his handle quickly. In passing over this the connections as per notch Nos. 6, 7 8 and 9 take place. On notch No. 6 a part of the resistance is cut back into circuit, so as to be ready for the parallel position, and on the seventh notch the Nos. 2 and 4 motors are

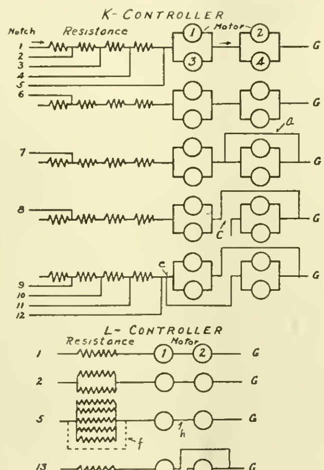


FIG. 3. SCHEMATIC DIAGRAM OF CONNECTIONS "K" AND "L" CONTROLLERS.

"shunted" by the connection (a). Only the Nos. 1 and 3 motors are then driving. On the next or eighth notch the connection is opened at C, and on the ninth this disconnected end is connected at e, just behind the resistance. Thus the Nos. 3 and 4 motors are running in parallel with the Nos. 1 and 2 motors, and all four motors are driving. The current which flows through the resistance divides equally through each pair of motors. The resistance is then cut out step by step, and on the thirteenth notch there is no resistance in circuit and the motors are in "Full Parallel Position."

In the diagram for the "L" controller we have shown a different arrangement of resistance and two motors instead of four. This is not a necessary arrangement, as the "L" Controller is adapted for four motors and the same type of resistance as the K controller, and vice versa. Referring to the schematic diagram for the "L" controller, the first notch shows one resistance, the second notch two resistances in parallel. The third notch there would be three resistances in parallel. One additional resistance is put in parallel on each notch until eight to twelve are in parallel, when on the next notch the resistance is short circuited by the connection f, shown dotted. It may appear, from first thought, that we are doing just the opposite from what we should do, *i. e.*, instead of decreasing the resistance on each step we are increasing. This is not so. On each step the resistance to the flow of current is less, as there are more paths for the current to take. The arrangement is analogous to two large pipes connected together by many small ones. If we open one small pipe a certain amount of water will flow. If a second one is opened there is an increase in the supply and this increases with each additional pipe that is opened.

On the notch of the controller, which cuts out all of the resistance by the connection (f), the motors are in the Series Position. As mentioned above, the type "L" controller is known by the method of changing from the series to the parallel position, which is to open circuit. The circuit is broken at L and then the motors are connected in parallel with one step of resistance in series. While this open circuit occurs, there is no power to the motors and no work is being done to drive the car. The result is that a decided jar is noticed in the middle of the acceleration of the car or multiple unit train. After the first position in parallel the resistances are connected in the circuit as on the first series notches, and are then cut out again by (f), when the controller is in the Full Parallel Position.

There are many sizes and types of both the "K" and "L" controllers with varying number of notches, but the principle is exactly the same, and Fig. 3 was used to illustrate the principle, not a particular controller of each type. There is, however, one K controller known as the "K 35," which does not use the "shunted" method as we have described, but what is known as the "budging" system. In this controller when the full series position has been reached a resistance is then connected across the line in parallel with the motors in such a way that by opening the circuit at a single point the motors are left in parallel with each other, and each pair in series with half of the resistance.

The Susquehanna Ry., Lt., & Pr. Company has ordered from the Westinghouse Electric & Mfg. Company, 18 quadruple equipments of 101 B 2 motors and K-28 B control. The Westinghouse Electric & Mfg. Company has also received an order for two quadruple equipment of 101 B A motors with K-35 M control, from the Union St. Ry. Company, New Bedford, Mass.

Mikado Type Locomotive for Buffalo, Rochester and Pittsburgh

The tendency to introduce locomotives of greater capacity and higher efficiency in operation is furnished by the new motive power recently installed on the Buffalo, Rochester and Pittsburgh Railroad.

This road has just received three Pacific type and seven Mikado type locomotives from the American Locomotive Company. Each of the two classes ranks among the most powerful locomotives of its type constructed by the builders. Both classes of locomotives are equipped with the latest approved fuel saving devices, such as firetube superheaters and brick arches with the view of securing greater economy in operation.

Freight traffic is at present handled by consolidation locomotives, having a total weight of 193,000 pounds, and a maximum tractive power of 38,660 pounds.

The new Mikados are designed to haul 1,100 tons or 46.6 per cent. heavier load than the consolidations up the grade at the same speed. This will increase the present maximum train load over the division from 1,850 to 2,250 adjusted tonnage.

In the case of the Mikado type locomotives, shown in the accompanying illustration, a theoretical maximum cylinder horsepower 36.3 per cent. greater than that of the present consolidations has been secured. At the same time, the increase in weight on driving wheels is only 26 per cent. Calculated on the same basis, the Mikados provide a maximum capacity of 2,100 horsepower and the consolidations only 1,543 horsepower. The Mikados have a weight on drivers of 216,500 pounds, and the consolidations 171,600 pounds.

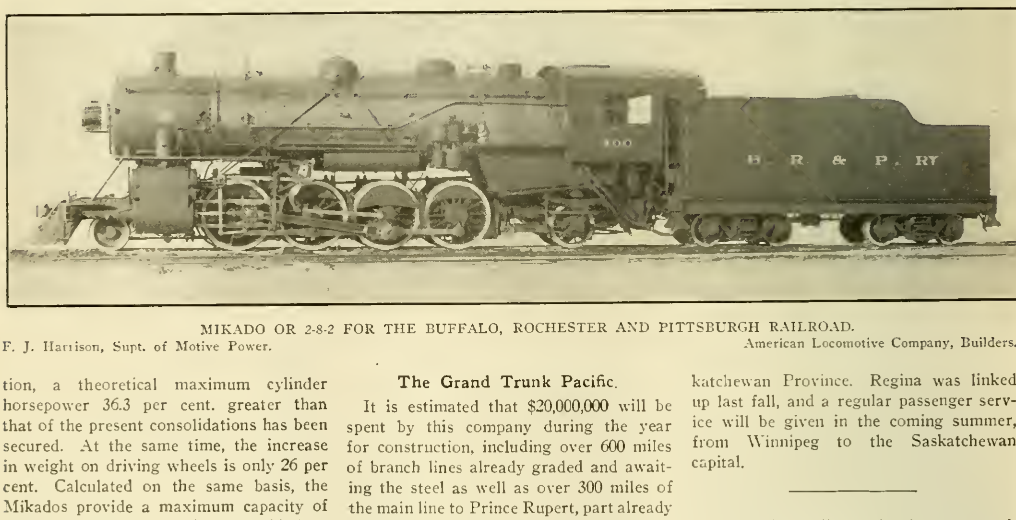
Comparing the boiler capacities: Conservatively estimating, it will require an evaporation per sq. ft. of heating surface per hour of not more than 12.4 pounds of steam at 180 pounds pressure to develop the maximum cylinder horsepower of the Mikado as compared with at least 14.6 pounds at 210 pounds pressure to give the maximum capacity of the consolidations.

This comparison shows the much larger boiler capacity provided in the Mikado type, which is one of the most important advantages of this type of wheel arrangement.

The two boilers are practically identical in design, the only difference being in the length of the smoke box. In the Mikado type the greater distance between the center of the cylinders and the forward driving wheels required an increase of 6 inches in the distance between the front tube sheet and the center of the cylinders. Both designs embody the new features introduced by the builders within the past two years. Among these will be noticed the outside steam pipes, the self-centering adjustable valve rod crosshead, the self-centering guide for the piston rod extension and the improved outside bearing trailing truck.

COMPARISON OF NEW PASSENGER AND FREIGHT LOCOMOTIVES AND THOSE WHICH THEY REPLACED.

	Passenger.		Freight.	
	4-6-2	4-4-2	2-8-2	2-8-0
Weight on drivers	163,500 lbs.	106,200 lbs.	216,500 lbs.	171,600 lbs.
Weight, total engine	258,000 lbs.	183,600 lbs.	273,500 lbs.	193,000 lbs.
Weight, total engine and tender	427,300 lbs.	305,100 lbs.	443,300 lbs.	323,750 lbs.
Tractive power	36,300 lbs.	26,700 lbs.	51,130 lbs.	38,660 lbs.
Cylinder, diameter and stroke	24½ x 26 in.	20½ x 26 in.	26½ x 30 in.	21 x 28 in.
Driving wheels, diameter	73 in.	73 in.	63 in.	57 in.
Boiler pressure	200 lbs.	210 lbs.	180 lbs.	210 lbs.
Boiler diameter	74 in.	70⅛ in.	74 in.	70⅛ in.
Firebox, length and width	108 x 75¼ in.	107 x 73¼ in.	108 x 75¼ in.	107 x 73¼ in.
Tubes, number and diameter	240—2 in.	333—2 in.	240—2 in.	354—2 in.
Flues, number and diameter	32—5⅜ in.	....	32—5⅜ in.	....
Tubes, length	20 ft. 0 in.	15 ft. 9¼ in.	20 ft. 0 in.	14 ft. 6⅜ in.
Heating surface, tubes	3,395 sq. ft.	2,733 sq. ft.	3,395 sq. ft.	2,672 sq. ft.
Heating surface, firebox, etc	240 sq. ft.	183 sq. ft.	240 sq. ft.	176 sq. ft.
Heating surface, total	3.635 sq. ft.	2,916 sq. ft.	3,635 sq. ft.	2,848 sq. ft.
Superheating surface	757 sq. ft.	....	757 sq. ft.	....
Grate area	56.5 sq. ft.	54.4 sq. ft.	56.5 sq. ft.	55.5 sq. ft.
Wheel base, driving	13 ft. 0 in.	8 ft. 0 in.	16 ft. 6 in.	16 ft. 0 in.
Wheel base, engine	33 ft. 3 in.	29 ft. 2 in.	34 ft. 9 in.	24 ft. 6 in.
Wheel base, engine and tender	65 ft. 11 in.	56 ft. 9 in.	67 ft. 4¾ in.	55 ft. 11 in.



MIKADO OR 2-8-2 FOR THE BUFFALO, ROCHESTER AND PITTSBURGH RAILROAD.
F. J. Harrison, Supt. of Motive Power. American Locomotive Company, Builders.

The Grand Trunk Pacific.

It is estimated that $20,000,000 will be spent by this company during the year for construction, including over 600 miles of branch lines already graded and awaiting the steel as well as over 300 miles of the main line to Prince Rupert, part already graded. This will leave about 200 miles of main line to be completed in 1913. It is estimated that steel will be laid through from Winnipeg to Prince Rupert, and traffic will pass over that line by the end of 1913. The branch lines to be linked up this summer will bring the main line of the Grand Trunk Pacific into touch with a number of enterprising western cities, including Moose Jaw, Saskatchewan, Brandon, Manitoba, Calgary, and Lethbridge, in Alberta Province, and Battleford and Prince Albert, in Saskatchewan Province. Regina was linked up last fall, and a regular passenger service will be given in the coming summer, from Winnipeg to the Saskatchewan capital.

Concerning railroad development work in the South and Southwest, leading manufacturers say railroad managers are showing that they are beginning to realize business is growing more rapidly than transportation facilities, and most of them are now in a position to make improvements on a larger scale than has been possible during the last three or four years. Many railroad officials recognize that railroad rate regulations have come to stay, and they are accepting this and adjusting their operations accordingly.

Oil Burning Locomotive in Great Britain

With the view of finding an escape from the recent coal famine and its attendant paralysing effects in Great Britain the Caledonian Railway Company—well to the front as usual—are experimenting with oil fuel for their locomotives.

In the engines so fitted the oil is stored in a cylindrical tank placed on top of tender in part of the space ordinarily occupied by coal. The oil flows from the tank to the engine injectors, which force it into the firebox at two separate points about 18 inches apart, where a current of steam from the boiler causes it to assume the form of fine spray spreading itself throughout the fire-box. By means of a thin layer of wood or coal fire covering the fire-bars, this spray is ignited, and so generates steam for the motive power, as well as for the injecting and spraying. The extent of the flame is regulated by a controlling valve on each of the injectors, and the operation of driving is, of course, the same as with coal fired locomotives.

The fire-box, in addition to the customary fire brick arch, is equipped with a fire brick wall to protect the copper front plate from the effects of the extraordinary heat given out by the oil fuel.

It is to be noted on the accompanying illustration that these special fittings are of such a kind as permit of the engine using oil fuel, or coal, as found desirable.

The company has at present 927 locomotives in service.

The following are the principal dimensions of the passenger engine illustrated:

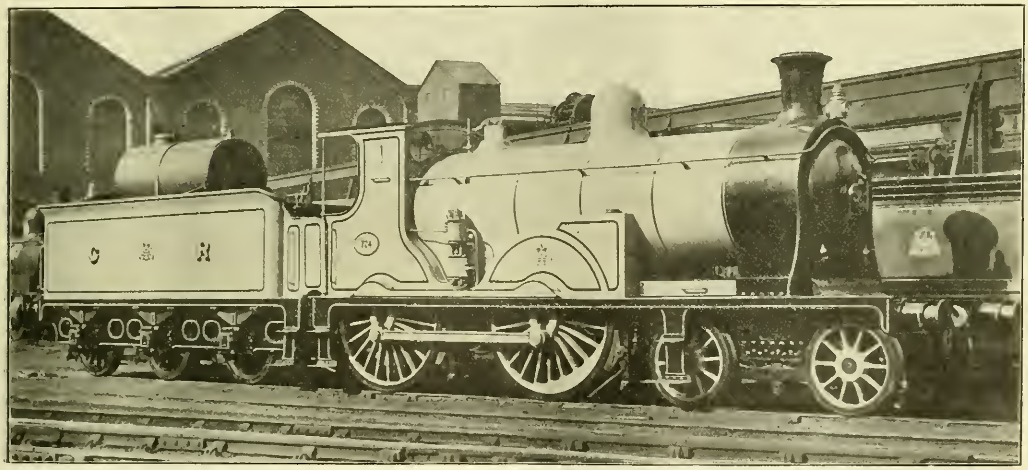
Gauge, 4 ft. 8½ ins.; cylinders, 18¼ by 26 ins.

Driving wheels—Diameter, 6 ft. 6 ins.; truck wheels, 3 ft. 6 ins.; tender truck wheels, diameter, 4 ft.

Weight—On driving wheels, 31 tons 5 cwt.; on front truck, 15 tons 14 cwt.; on tender trucks, 39 tons 1 cwt.; total engine and tender, 86 tons.

Heating surface of 265 tubes, 1,284.45 ft.; firebox, 118.78 ft.; total, 1,403.23 ft.; grate area, 20.63 ft.

Tender—Tank capacity, 3,570 gals.; fuel space, 3 tons of coal and 520 gals of oil.



OIL BURNING LOCOMOTIVE ON THE CALEDONIAN RAILWAY, SCOTLAND.

The Vulcan Iron Works, Wilkesbarre, Pa., are constructing three contractor's locomotives for Richmond and Evans, Minneapolis, Minn., four of the same type for the Purcell Construction Company, Tamaqua, Pa., and two of similar construction for T. Burke, Scranton, Pa., and two for Dutton & Timson, Secreton, Sask, Canada.

Canadian Pacific.

The Canadian Pacific Railway is calling for tenders for constructing machine shops, roundhouses, turntable, and repair tracks in Victoria West, expenditure $100,000. Such works are now all at Wellington, but hereafter the car shops will all be at Victoria.

Canal Zone.

Carrying approximately 2,000 passengers on every daily trip the labor train which leaves Panama, Canal Zone, every morning for Pedro Miguel and returns at night is the largest ever operated for canal work, and is said to carry more passengers than any other regularly operated train in the world. The train consists of fifteen cars.

Man Slayers.

India has about ten times the population of the United States and the material increase has been restrained a little by the ravages of wild beasts. In 1910 fifty-five persons were killed by elephants, twenty-five by hyenas, 109 by bears, 851 by leopards, 318 by wolves, 853 by tigers and 688 by other animals, including wild pigs. No less than 22,478 died from the bite of poisonous snakes. The grand total of mortality is 24,878.

During the same year 93,000 cattle were also killed by wild beasts and snakes.

The losses on the part of inhabitants of the jungle were nearly but not quite as great as those of their human enemies and domesticated animals combined. Ninety-one thousand one hundred and four snakes and over 19,000 wild beasts of various kinds were killed.

The natives of India do little to keep down the number of man-slaying animals, but they are always ready to aid white sportsmen who find enjoyment in hunting these destroyers of the people.

Lehigh and New England.

With the grading about finished of the Lehigh & New England from Danielsville, four miles east of Allentown, Pa., to Tamaqua, which is to cost $3,000,000, track-laying will be carried on as rapidly as circumstances will permit with a view of completing the work by the middle of June. All the necessary bridges, thirty-two in number, are in place, and the road will soon have a line of its own from the mines in Pennsylvania across the State, and through New York and New England into Boston by the Poughkeepsie bridge route.

Items of Personal Interest

Mr. G. E. Constant has been appointed master mechanic of the Ann Arbor at Owosso, Mich., succeeding Mr. C. P. Burgman.

Mr. C. S. Taylor has been appointed general foreman of the Atlantic Coast Line at Wilmington, N. C., succeeding Mr. H. B. Goodnight.

Mr. C. S. Sisler has been appointed master mechanic of the Baltimore & Ohio at Cumberland, Md., and F. W. Boardman has been appointed general foreman of the same road at Washington, Ind.

Mr. James Dickson has been appointed general foreman of the locomotive and car departments of the Burlington at Quincy, Ill.

Mr. Frank Rusch has been appointed acting general mechanic of the Chicago, Milwaukee & Puget Sound with office at Tacoma, Wash.

D. F. CRAWFORD,
Vice-President, M. M. and M. C. B. Ass'n.

Mr. John J. O'Neil has been appointed superintendent of motive power and machinery of the Chicago, St. Paul, Minneapolis & Omaha, with office at St. Paul, Minn.

Mr. J. L. Smith has been appointed general foreman of the motive power department of the Delaware, Lackawanna & Western at East Buffalo, N. Y.

Mr. E. T. McDonald has been appointed assistant master mechanic of the Utah lines of the Denver & Rio Grande, with office at Helper, Utah.

Mr. H. B. Brown has been appointed assistant superintendent of machinery of the Illinois Central at Memphis, Tenn.

Mr. Peter Vosen has been appointed master mechanic of the Wabash at Decatur, Ill. He succeeds Mr. E. O. Shively.

Mr. Chas. Landberg has been appointed general foreman of the Spokane, Portland & Seattle at Vancouver, Wash. He succeeds Mr. J. B. Wyler.

H. T. BENTLEY,
President, M. M. Ass'n.

Mr. J. M. Monroe, formerly general foreman of the Southern Railway shops at Columbia, S. C., has accepted a position with the Hunt-Spiller Manufacturing Corporation of Boston, Mass.

T. RUMNEY,
Vice-President, M. M. and M. C. B. Ass'n.

Mr. W. I. Rowland, formerly master mechanic of the Baltimore & Ohio at Grafton, W. Va., has been appointed assistant road foreman of engines of the Baltimore division, with office at Baltimore, Md.

Mr. John Hair, formerly superintendent of motive power of the Baltimore & Ohio at Cincinnati, Ohio, has been appointed safety inspector, representing the mechanical department in the General Safety Committee, with headquarters at Baltimore, Md.

Mr. E. A. Gilbert has been appointed general inspector of the motive power department of the Southern Pacific, with office at San Francisco, Cal.

Mr. E. E. Wright has been appointed in charge of the central sales district, which has been opened by the McKeen Motor Car Company at 1451 Marquette building, Chicago, Ill.

D. R. MAC BAIN,
Vice-President, M. M. Ass'n.

Mr. Otis A. Garber has been appointed master mechanic of the St. Louis, Carbondale, Murphysboro, Eldorado and Carondelet districts, and the Johnson City branch of the Illinois Central, with headquarters at East St. Louis, succeeding Mr. W. H. Donley, assigned to other duties.

Mr. C. W. Stark has been appointed supervisor of mechanical instruction and examination of enginemen for the Eastern district of the New York Central lines, in place of Mr. D. Cassin, assigned to other duties.

Mr. J. M. Chaffee has been appointed road foreman of engines on the Mohawk

division of the New York Central Lines, in place of Mr. C. W. Stark, promoted.

Mr. W. J. Hoskin, formerly master mechanic of the Chicago & Alton at Bloomington, Ill., has been appointed master mechanic of the Illinois Central at Paducah, Ky.

Mr. A. P. Pendergast has been appointed superintendent of motive power, and Mr. H. B. Voorhees has been appointed general superintendent of the Cincinnati, Hamilton & Dayton, with offices at Cincinnati, Ohio.

A. STEWART,
President, M. C. B. Ass'n.

Mr. H. H. Hale has been appointed superintendent of car service of the Cincinnati, Hamilton & Dayton, and Baltimore & Ohio Southwestern, with headquarters at Cincinnati, Ohio.

JOSEPH W. TAYLOR,
Joint Secretary, M. M. and M. C. B. Ass'ns.

Mr. George Brodshaw has been appointed general safety agent of the New York Central with headquarters at New York. He reports to the general claims attorney and to the general manager.

Mr. E. S. Stuart, a brother of Mr. J. C. Stuart, vice-president of the Erie, has quit the Bureau of Explosives of the Interstate Commission to enter the services of the Buffalo, Rochester & Pittsburgh as special agent. He was formerly a trainmaster on the Pere Marquette.

Mr. E. J. Wright, superintendent of the New York Central's Hudson division, has been promoted to general superintendent of the eastern district, to succeed W. J. Tripp, now assistant general manager. Mr. Wright's successor is C. Christie, formerly superintendent of the St. Lawrence division of the R. W. & O.

Harry T. Bentley.

Mr. H. T. Bentley, president of the American Railway Master Mechanics' Association, entered railway service in 1877 with the London & Northwestern railway of England. In 1887 he was appointed engine house foreman at Chester, England. In 1892 he came to America and was shortly afterwards appointed roundhouse foreman on the Chicago & Northwestern at Boone, Iowa. In 1899 he was made master mechanic of the Madison division of the same road, and latterly held the same position on the Iowa division. In 1902, he was appointed assistant superintendent of motive power and machinery, and is now in his twentieth year of service on the same road.

D. F. Crawford.

Mr. David F. Crawford, first vice-president of the American Railway Master Mechanics' Association, joined the organization in 1900 and has been noted as a hard working member. Mr. Crawford has gone through a remarkably fine training for a high position in railroad service. He was educated at the Pennsylvania Military Academy, then went through the apprentice course at Altoona. His first promotion was to be inspector of the tests department of the Pennsylvania Railroad, then assistant master mechanic, which led him to the position of assistant superintendent of motive power; finally superintendent of motive power of the Pennsylvania lines west of Pittsburgh, the place he now fills. Mr. Crawford comes from an old Scottish family and bears the name of David, which ran through that family. The mother of Scotland's hero, Sir William Wallace, was a Crawford. The Earls of Crawford were very conspicuous in Scotland history and there generally was a wicked David in evidence. The principal estates of the family were in Ayrshire and they still hold a burial vault in Alloway's Auld Haunted Kirk, the scene of the witch's dance, described in Burns' Tam O'Shanter. In Highland lore the Crawfords are associated with the clan Lindsay.

T. Rumney.

Mr. T. Rumney, second vice-president of the American Railway Master Mechanics' Association, was employed for over ten years by the Erie Railroad, holding positions as foreman, general inspector of machinery, master mechanic, assistant mechanical superintendent and latterly general mechanical superintendent. In January of the present year he accepted a position with the Rock Island as assistant second vice-president, in charge of the mechanical department.

ANGUS SINCLAIR,
Treasurer, M. M. Ass'n.

Donald R. MacBain.

Mr. D. R. MacBain, third vice-president of the American Railway Master Mechanics' Association began railroading on the Canada Southern in 1876. He continued on the same road, now the Canadian division of the Michigan Central, until 1908. While in the service of the company he held many positions, being

C. E. FULLER,
Vice-President, M. C. B. Ass'n.

traveling engineer, master mechanic and latterly assistant superintendent of motive power, with office at Detroit, Mich. In 1908, he entered the service of the New York Central Lines and in 1910 was appointed superintendent of motive power of the Lake Shore and Michigan Southern, the Lake Erie and Western, and the Chicago, Indiana & Southern, with offices at Cleveland, Ohio.

C. E. Fuller.

Mr. C. E. Fuller, first vice-president of the Master Car Builders' Association, began his railroad career as draftsman with the Vandalia in 1880. In 1889 he was appointed general foreman of the Hornell shops on the Erie. In 1890 he was made master mechanic of the New York division of the Erie. In 1892 he was appointed superintendent of motive power of the central Vermont, with office at St. Albans, Vt. He returned to the Erie in 1901, as assistant mechanical superintendent. In 1903 he was appointed superintendent of motive power of the Chicago & Alton, and in 1908 he entered the service of the Union Pacific, and after serving for some time as superintendent of motive power, he was appointed assistant general manager, which position he still holds.

J. S. LENTZ,
Treasurer, M. C. B. Ass'n.

J. S. Lentz.

Mr. John S. Lentz, treasurer M. C. B. Association, entered the service of the Lehigh Valley Railroad Company in 1865, and has continued in the service of the company up to the present time. During the period from 1880 to date he has been superintendent of the car department, assistant superintendent of motive power. He has been particularly active in the welfare of the M. C. B. Association.

Obituary.

MRS. JOHN KIRBY.

People who have been in the habit of attending the Master Car Builders' Convention will be sorry to learn that they will never again meet Mrs. John Kirby, who died at the family home in Adrian, Mich., on May 1. Mrs. Kirby, a remarkably sweet faced lady, was regularly in attendance at the conventions for years and was exceedingly popular among old and young, although of a very retiring disposition. She was born in 1829 and was 83 years old at the time of her death. We voice the sentiments of all who knew this estimable old lady in extending heartfelt sympathy to Mr. Kirby and to all the family at the loss of the well loved wife and mother.

Mechanical Conventions at Atlantic City.

On behalf of the executive committees of the American Railway Master Mechanics' Association, Secretary Taylor has sent the following circular to members:

"As you probably are aware, a change has been made in the method of taking care of the expense in connection with the entertainment features at the convention, for the reason that in the past considerable criticism was heard to the effect that each year the entertainments were becoming more elaborate, costly and formal, and, on account of the growth of the Association, it was felt that the Supply Men should be relieved of the burden of paying for our entertainment. This year, for the first time, formalities will be dispensed with and, while there will be dances, a baseball game, musicales, etc., no ball or reception will be given, and the expenses of whatever entertainments are furnished will be taken care of out of the treasury of the Association. It is, therefore, hoped that all members who can make it convenient to attend the convention will do so, as the business end of it, the meetings and exhibits, will maintain their high standard, and the fact that informal entertainments will be given, so that all can attend, should be sufficient inducement for you to bring your wives and families with you.

"We are desirous of making this a most satisfactory convention and are looking forward to your helping us attain this result."

To Store 1,600 Car Loads of Apples.

The people of Colorado have an abiding faith in the future of apple raising within the State and they are preparing to market the fruit in the most approved style. They are erecting an asbestos fireproof store house that will provide accommodation for 1,600 car loads of fruit.

From the standpoint of climate and location, Denver has long been recognized as the natural distributing center of the box apple trade, but, because of the absence of sufficient storage room, hundreds of cars of Colorado apples have been sent each year to Syracuse, N. Y.

The plant will consist of three buildings, all of steel and stucco-asbestos without an ounce of wood or other inflammable material in their construction.

The storage warehouse will be 80 feet high—approximately nine stories, including the basement and subbasement—100 feet wide and 200 feet long.

In addition to the storage of fruits, meats and other perishable products, the company will manufacture ice, and will introduce a system of icing cars without the necessity of removing or disturbing the contents.

C. GARTON, B. Sc.

Mr. C. Garton, B. Sc., has been appointed general manager of the American branch of the Westralian Improved Rotary Spark Arrester Company, which has recently been established in America, with offices at 42 Broadway, New York. Mr. Garton is an Australian engineer and has been engaged in bridge construction and other engineer work in that colony.

A new occupation has been found for mechanical engineering school graduates. The presence and active habits of mosquitoes has aroused the ire of certain people in New Jersey, and a crusade has been instituted by the Essex County Mosquito Extermination Commission, which has appropriated $75,000 to perform the suppressing, and graduates of the Massachusetts Institute of Technology have been hired to do the supervising.

From all appearances the opportunities for the crusaders and supervisors to show their skill will be excellent. The reports are awaited.

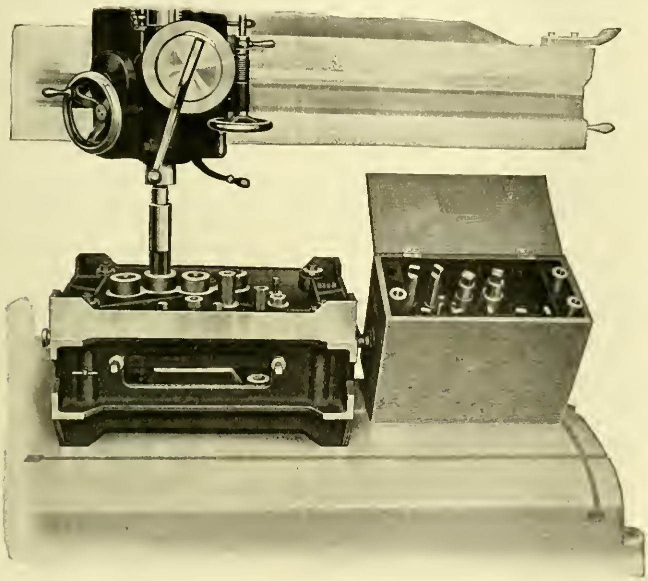
The Radial Drill as a Boring Machine

It may be stated without fear of contradiction that with the probable exception of the engine lathe, no machine tool has been improved in recent years as greatly as the Radial Drill. This type of machine has been improved and developed until now it not only serves the purpose of a Radial drilling and tapping machine, but also does service as a boring machine as well. In fact, on some classes of boring the Radial Drill has proven itself to be far superior in every respect to the Horizontal Boring Machine.

The American Tool Works Company, of Cincinnati, have in their works a large number of Horizontal Boring Mills of the very best makes, and therefore have had ample opportunity to judge the boring qualities of the Radial Drill in comparison with the Horizontal Boring Machine. For example, the Aprons on "American" 24-in. High Duty Lathes were formerly bored on a Horizontal Boring Machine in lots of 12, each lot requiring 72 hours. This same Apron is now bored on a 6-ft. "American" Radial Drill, by means of a jig, as shown by illustration, the actual time consumption being 24 hours. It will be evident from this that a saving of 48 hours has been accomplished on this operation, or an actual time saving of 66⅔ per cent.

Likewise, there are many jobs that can be much more advantageously handled on a Radial Drill than on a Horizontal Boring Machine, and it would, therefore, certainly pay every manufacturer, who has any boring to do, to investigate this subject.

It would be idle to discredit the advantages claimed for the Horizontal Boring Machine. We fully realize that there are numerous jobs that can only be satisfactorily handled on a machine of this type. The object of this article, therefore, is to call attention to the fact that there are many jobs, probably some that are now being done on a Horizontal Boring Machine, that can be handled much more economically on a Radial Drill.



AMERICAN TOOL WORKS CO.'S RADIAL DRILL.

Milwaukee and Harriman Lines.

Particulars have been made public of a new traffic agreement between the Harriman Lines and the Chicago, Milwaukee & St. Paul which will materially increase the freight hauling business of the latter railroad. By an arrangement with the Union Pacific, the Milwaukee road will haul the Union Pacific freight from Omaha to Chicago, business which hitherto has been done exclusively by the Chicago & Northwestern. The Milwaukee road also acquires the right to run trains over the Harriman Lines to San Francisco.

Report says that the immediate result of the new deal will be the double tracking of the Milwaukee road from Omaha to Chicago.

The Westralian Spark Arrester.

The Westralian Improved Rotary Spark Arrester, which is being rapidly adopted in many parts of the world, and meeting with warm commendations from many eminent engineers, and now being introduced in America, is an Australian invention. It consists essentially in an outer casing which takes the place of the ordinary smoke stack. The casing contains two rotators revolving in opposite directions and interengaging. These rotators are mounted on specially designed bearings and are driven by the exhaust blast. These rotators move easily and are no kind of hindrance to the exhaust and do not in any way affect the steaming qualities of the locomotive. The vanes are of wire mesh or perforated metal with small projections attached, known as spark catchers. Steam, smoke and gases escape easily through the revolving vanes. All sparks and cinders are retained, and by a series of diaphragms draw the sparks away from the spark catchers and direct them down the spark chutes to the cinder hopper. The apparatus requires no kind of attention, its action being automatic with the repercussions of the exhaust. The vanes may be replaced at a trifling cost. No netting is necessary in the front end.

Several of the leading railroads in America are already arranging for trials of the device. The Forest Commission are making a special investigation in regard to its merits, and the device seems to justify all the claims of its promoters.

Asbestos.

We know of no material whose use in the United States has expanded so rapidly as asbestos. According to Consular and Trade reports, 71 tons of asbestos were mined and marketed in the United States in 1890, and in 1910 it had risen to 3,693 tons, while 1911 the consumption in this country had risen to 57,124 tons. The uses to which asbestos is applied in the United States is mostly for boiler and steam pipe covering, steam gland packing and fireproof cloth, much of which is converted into theater curtains.

Asbestos is a Greek word, meaning "unquenchable," but used in the sense "inconsumable." Chemically it consists of silica, magnesia and lime or pyroxene. Asbestos was woven into cloth by the Greeks and was used for wrapping dead bodies when they were burned in the funeral pyre that the ashes might be preserved. In ancient times the lamps that were always kept burning in the temples had wicks made from asbestos fiber. For many years after the revival of industrial activity asbestos was little used in the arts, and it is only recently that its usefulness has been fully recognized.

Safety Headlight.

The Dressel Railway Lamp Works, 3860-80 Park avenue, New York City, have produced the most powerful oil headlight which has ever been designed. The headlight is known as the Bunn Railway Safety Headlight, and is fitted with an 18-ins. White Corning Lens, made of the clearest glass of optical design. This lens is the result of scientific efforts on the part of the Corning Glass Works, Corning, N. Y.

The lens is adjustable to the front goggle or holder, and can be readily cleaned or replaced. The No. 500 Dressel Headlight Burner is the largest type of the Dressel Burner, made of heavy brass, all parts being adjusted without the use of solder or perforated metal as usually applied to headlight burners. With the chimney design especially adapted for this burner it will overcome the difficulties heretofore found. The 12-ins. glass mirror reflector is very substantially made, having asbestos backing. The ventilation is so arranged that all parts are easily reached for purposes of cleaning, and with the top draft principle of ventilation, a steady clear light is assured, and over-heating will not occur. The case has a reinforced bottom and back with an asbestos lining, and throughout is very strongly constructed, having holder for extra chimney and extra heavy brass filler cap with chain attached. In a recent test this headlight, with a 16-in. lens, produced over 3,000 candle-power light, and with the larger diameter of 18-ins. lens, the increased illuminating power would show from 20 to 25 per cent. greater.

The most rigid State laws can be met with this headlight, and an object the size of a man can be clearly distinguished at a distance of 800 ft.

On page 11 of this issue a cut of the Bunn Railway Safety Headlight is shown, as well as a cut illustrating the No. 250 Lake Shore Pattern of Headlight, which is likewise a very powerful oil headlight, supplied with a 23-ins. silver-plated copper reflector, 15 ins. deep, with No. 100-A Dressel Headlight Burner. The front glass is 23 ins. dia. Plain Glass, 3/16-in. thick. This headlight is also built to meet the requirements of certain exacting State laws, and is now being successfully used by several of the leading railroads.

The particular features of this lamp are compactness and strength. The door is made of malleable iron, and instead of the case being made with the bottom in one piece, the body is of cylindrical design and is fitted with heavy malleable iron stands.

Up to within recent years all headlights were made with wood bottom, to which the case was joined by screws or nails, and while this method was in general use it was quite undesirable, for the board frequently became saturated with oil and often caught fire, therefore the headlights as now manufactured are principally furnished with the cases made in one piece, which includes the steel bottoms, and with angle iron frames, which are readily bolted to the platforms.

The Headlight should be located on the center of the boiler, directly over the number-plate, and where it is accessible and the light rays are brought nearer to the tracks. The height of present locomotives makes it imperative that the headlights should be lowered to the front number plate.

Both of the above headlights can be seen at the M. C. B. & M. M. conventions at Atlantic City, N. J., at the exhibit of The Dressel Railway Lamp Works.

Oldest Metal.

A recent paper presented to the Royal Institution at London, in discussing the question of the metals used by the great nations of antiquity, pointed out that gold was probably the first metal known to man because it is generally found native.

The oldest metallic objects to which we can assign a probable date are thought to be those found at Nagada in Egypt, supposed to have belonged to King Menes, and consisted of some bits of gold and a bead, a button, and a fine wire of nearly pure copper. If the excavation has been properly identified these objects are at least 6,300 years old. Nearly all the ancient gold that has been examined contains silver enough to give it a light color. It was gathered by the ancients in the bed of the Pactolus and other streams of Asia Minor.

Valuable Information Free.

Superintendents of motive power, master mechanics, foremen or machine operators should secure a copy of "Tips on Efficiency," just issued by the American Tool Works Company, Cincinnati, Ohio. The thirty-two pages are filled with so much information in regard to the latest devices calculated to promote efficiency that we cannot at present writing enter into details. Suffice it to state that the tips on shop efficiency are of paramount value and should be in the hands of all who are interested in the perfection of mechanical work combining efficiency and economy. Write to the American Tool Works, Cincinnati, Ohio, for a copy of "Tips on Efficiency."

London gets a shower of soot weighing 4½ pounds to the acre every day, or 1642.5 pounds a year, say the scientists of Old England. Pittsburgh scientists have not yet been heard from.

Railroad Notes

On May 12 a fire broke out in the round house of the Boston & Maine Railroad and nine locomotives were destroyed.

The Grand Rapids & Indiana has ordered three switching locomotives from the Lima Locomotive & Machine Company.

Work has begun on the Duluth, Minneapolis & Pacific, which will give the Canadian Northern an entrance into Duluth.

The Missouri, Oklahoma & Gulf has ordered five Mallet and four consolidation locomotives from the Baldwin Locomotive Works.

The St. Louis Southwestern has ordered eighteen consolidation and four mogul locomotives from the Baldwin Locomotive Works.

The Rock Island recently purchased forty high-power electric headlight equipments from the Remy Electric Company, Anderson, Ind.

The Minneapolis, St. Paul & Sault Ste. Marie has begun the construction of an additional branch from Fordville, N. D., to Drake, 130 miles.

The Chicago, Terre Haute & Southeastern has ordered five consolidation freight locomotives from the American Locomotive Company.

The New York, New Haven & Hartford has placed an order for fifteen consolidation locomotives with the American Locomotive Company.

The Delaware & Hudson are reported to be on the market for an increase in motive power, among which will be five consolidation locomotives.

The Oregon Short Line has put 1,500 additional men on its pay roll in Utah and Idaho, and will increase the number to 3,000 as soon as they can be obtained.

The Detroit & Mackinac has ordered three ten-wheel locomotives from the American Locomotive Company. The weight in working order will approach 190,000 lbs.

In an address before the Transportation Club of Peoria, Ill., W. L. Ross, vice-president of the Alton & Clover Leaf, advocated the joint ownership and operation of railway terminals in large cities.

The Canadian Pacific has ordered 25 consolidation locomotives from the Montreal Locomotive Works, and are engaged in the construction of ten mikado locomotives at the company's Montreal shops.

The Lake Superior & South Dakota Company has been incorporated in Minnesota and will proceed with the construction of a road from Duluth, Minn., to the western boundary of Big Stone county, 225 miles.

The Southern Pacific is in the market for 100 fifty-ton steel underframe stock cars, 100 fifty-ton all-steel gondola cars, 250 fifty-ton steel underframe flat cars, 1,200 fifty-ton steel underframe box cars and 100 fifty-ton steel underframe work cars.

Six direct-current 60-ton Baldwin-Westinghouse electric locomotives and twenty Westinghouse car equipments with H. L. control have been purchased by the Southern Pacific Railroad Company, for operation on the Southern Pacific and the Pacific Electric Company properties.

The Winnipeg, Salina & Gulf Bay Railway, Salina, Kan., has been incorporated in Oklahoma and will run from Omaha, Neb., to Oklahoma City, from Kansas City to Salina, and from Kioma, Kan., by way of Sugmon, Okla., to Des Moines, N. M., making a total distance of nearly 1,100 miles.

The Pere Marquette contemplates making important additions to its motive power. An increase of thirty-five consolidation, thirty-five mikado and five Pacific type locomotives is already decided on, and a still further increase will be made during the summer.

The Santa Fe system proposes to build a tunnel and to improve its track at Cajon Pass. The grade will be lowered from 3 per cent. to 2.24 per cent. The total cost of the work is estimated at $1,000,000. The line at the lower end of the pass will be double-tracked.

The Harriman Lines are reported to have ordered 5,700 fifty-ton box cars from the Pullman Company, 1,000 thirty-ton refrigerator cars from the American Car and Foundry Company, 750 fifty-ton box cars from the Standard Steel Car Company and 700 fifty-ton flat cars and 300 fifty-ton all-steel gondolas from the Bettendorf Axle Company.

When railway supplies are in active demand it may be concluded that the business of transportation is brisk. Steel is, of course, largely used by railroads, but they do not order steel until improvements are about to be carried out. That being the case it is a hopeful sign that the orders for steel placed in April were 360,044 tons greater than the March orders.

Books, Bulletins and Catalogues

Webster's New International Dictionary.

G. & C. Merriam Company, Springfield, Mass., has just issued a new and enlarged edition of Webster's Dictionary. In point of magnitude the book is not only great, but great in everything that tends to make it the best thing of its kind published. There are over 400,000 defined words and phrases. It extends to 2,700 pages and contains 6,000 illustrations. As is well known, the work was begun by Dr. Noah Webster in 1843, and has been steadily and consistently developed under the management of a single publishing house ever since. The last edition was published in 1890, with a supplement in 1900. The present edition, it is needless to say, very far surpasses its predecessors. In its present form it properly assumes the position of a national institution, and has become the standard repository of the leading language of all time. For fuller particulars and prices apply to the publishers.

Report of the Interstate Commerce Commission.

The twenty-fifth annual report of the Interstate Commerce Commission, bringing the work of the commission up to December, 1911, has just been issued and forms a substantial volume of 355 pages. The bulk of the book is occupied with citations of cases in which many railroads are involved. To the ordinary reader such reports are not particularly interesting, but the matter is of vast import to those interested. Much light is thrown upon many subjects of importance to railway men. The Ash-pan act, the act relating to automatic stops, block signals, boiler inspections, broken rails and other matters of much interest are referred to. Probably the most important conclusions arrived at in the various investigations are the superiority of steel equipment as compared with wooden cars, and the necessity of ascertaining and improving the physical condition of tracks and roadways.

The Modern Locomotive.

G. P. Putnam's Sons, New York, have just issued a book on the Modern Locomotive by C. Edgar Allen. It presents in an elementary and popular way a history of the development of the British locomotive. The style is clear and concise. The illustrations are excellent. While the book is well adapted for the use of young students, there is much matter of value to advanced engineers. The work extends to 174 pages, and is substantially bound in ornamental cloth, and sold at 40 cents per copy.

Dean Boiler Tube Cleaner.

The William B. Pierce Company, 327 Washington street, Buffalo, N. Y., have just issued a bulletin in regard to the Dean boiler tube cleaner. Their apparatus has been successfully tested on several of the leading railroads, including the New York Central, at Depew, N. Y., and on the Vandalia, at Terre Haute, Ind. In a number of tests the flue was cleaned in less than four minutes. The Dean device is something entirely new. A cylinder is entered into the flue fitting snugly, and steam or compressed air operates a vibrator which taps the flue from 3,500 to 6,000 times a minute, causing a slight tremor in the tube without any injury to the tube. Every particle of scale is loosened and is blown out by the exhaust, leaving the flue as clean as when new. Arch tubes of the most acute angle are readily cleaned in the same way, the cylinders being adapted to suit various sizes of flues. Send for a copy of the new bulletin.

Graphite as a Surfacer.

Testimonials to the merits of graphite as a lubricant are so numerous that the Joseph Dixon Crucible Company, Jersey City, N. J., are unable to publish even a small fraction of them. Oil or grease often fail, but graphite never fails to keep metal surfaces apart. Its ability to knit over any kind of metal a covering, tough, thin and unctuous is amazing. There is no possibility of an abrasion where graphite is used. It induces sliding and cooling, like ice. In lubrication it is the horizon beyond which we cannot see. Weight or speed do not affect its efficacy. Send for the company's descriptive pamphlets if you are not already convinced.

The Boss Nut.

The Boss Nut Company, Chicago, Ill., have issued a neat pamphlet presenting in a brief and interesting form a description of the exclusive features of the Boss nut. A glance at the illustrations show that the lower or holding nut is of the usual type, while the upper or Boss nut is concaved with a deeper arch than the upper face of the lower nut. The upper nut being thinner when tightened by a wrench, is slightly flattened and cannot be again removed except with a wrench. No kind of vibration can shake it off, as a slight valley is created in the thread of the bolt and nut. They are cheaper than common nuts. No cotter pins are required. They are absolutely fool proof, and are coming rapidly into favor. Copies of the pamphlet may be had on application.

Wedge Lock Coupler.

The Gold Car Heating and Lighting Company, New York, the well-known inventors and manufacturers of car heating and lighting apparatus, electric heaters and railway supplies, have issued a series of illustrated bulletins descriptive of their devices, all of which are of particular interest to railway men. We recently described their Ideal pressure regulator and also their Wedge lock coupler, which have already established for the enterprising firm an enviable reputation. In addition to them the new bulletins describe and illustrate their vapor system, thermostatic temperature regulator, cyclone ventilators, double coil system, of hot water circulation, and quick detachable ventilated core electric heaters, all of which are of merit in point of efficiency and economy. Copies of these illustrated bulletins should be in the hands of all who are interested in the subject of couplers.

Ballast Spreading.

Now that railroad construction work is being projected all over the country, those who have not witnessed the operations of The Mann-McCann Company's Spreader, Bank shaper, Folding snow plow, Bank builder, Ballast spreader, Grade elevator, Ditcher and Flanger, can form little idea of the immense saving that can be accomplished by the use of this powerful but flexible machine, or rather combination of machines. A small locomotive with two men can finish up from 30 to 50 miles of grade on both sides per day, doing better work than section men, and save over $1,000 per day. Send for catalogue and prices to the company's office, 1918 Fisher Building, Chicago, Ill.

Oil Filtration.

Bowser's Booklet is out in a new edition, with descriptions and illustrations of the company's oil filtration and circulating system. The booklet fully describes the system, but it should be seen to be properly appreciated. In its operation it not only precipitates all impurities from the oil, but has the rare quality of separating water from the oil. It also provides for the storage and use of refuse oil. It controls and levels the oil in tanks. All parts are accessible when in operation, and there are visual means of ascertaining the condition of all of the parts. The facility for cleaning is also of the easiest. Send for particulars and prices to S. F. Bowser & Co., Fort Wayne, Ind.

J-M Asbestos.

Catalogue 252, comprising a handsome volume of 342 pages, profusely illustrated, and descriptive of J-M, asbestos, magnesia and electrical railroad supplies, is at hand, fresh from the H. W. Johns-Manville Company, Publicity Department, New York, and is in itself not only a sure means of increasing business, but is a sign of it. As is well known, the firm are not only the oldest, but the largest manufacturers of asbestos and magnesia products in the world. The catalogue is more than twice the size of the last issue published three years ago, and is a sure indication of the great growth of the railroad department of the enterprising company's business. List prices and copies of the catalogue may be had on application, and it may be added that there is a liberal discount on railroad business.

Scully Blue Book.

The Scully Steel and Iron Company, Chicago, have discontinued the publication of their monthly stock list of iron, steel, machinery, heavy hardware, tools and supplies, and in place of these periodical publications have issued a fine annual, that of 1912 extending to 260 pages, bound in leather and fully illustrated. The elegant catalogue should be in the hands of all interested. A series of tables enhance the value of the work and comprise over 70 pages of matter of great interest to boiler manufacturers and other steel users, and much of the information in regard to riveted joints, cut joints and bursting pressure of boiler shells is entirely new and embraces much valuable matter collected by the Hartford Steam Boiler and Inspection and Insurance Company. Copies of the Scully Blue Book may be had on application.

Vertical Lift Bridges.

A sixteen-page pamphlet on the Evolution of Vertical Bridges, by H. G. Tyrrel, and published by the University of Toronto Engineering Society, presents in a concise and interesting way the story of the development of vertical lift bridges from the earliest period of history to the present time. The various designs are fully explained and estimates of cost of the more modern types given. It need hardly be stated that the most important bridges of the kind are in operation in America, and the author has done good service in presenting in brief form a description of these structures.

Drilling Small Pieces.

A piece of metal of such a shape that it is hard to hold and too small to bolt on a drill-press table makes a difficult thing for drilling. Such a piece of metal can be kept from turning by placing a stiff piece of paper or emery cloth between it and the table. This method is very effective.

Knew His Father.

A little lad was desperately ill, but refused to take the medicine the doctor had left. At last his mother gave him up. "Oh, my boy will die; my boy will die," she sobbed. But a voice spoke from the bed, "Don't cry, mother, father'll be home soon and he'll make me take it."

A Cautious Boy.

A little chap was offered a chance to spend a week in the country, but refused. Coaxing, pleading, arguing, promising of untold wonders alike brought from him nothing but the stubborn ultimatum, "No country for me." "But why not?" some one asked him. "Because," he responded, "they have threshing machines down there in the country, an' it's bad enough here, where it's done by hand."

Sarah's Bargain.

An ex-mistress, meeting her ex-domestic, a remarkably capable woman, finding that the latter had turned washerwoman and had married the noodle of the village, said to her: "Oh, Sarah, why ever did you marry such a stupid man?" "Well, ma'am," was the reply, "you see, there's a deal of carrying in our trade, and if I hadn't married he I should have had to keep a donkey."

A Philosophic Irishman.

An old Irishman named Patsy Finnigan was just recovering from a very bad illness, and was out "taking the air." On his way he met "his reverence," the parish priest. "Ah, Patsy, me boy," said the good man, "is that yourself? Sure, I'm glad to see you out again. You have had a very bad time. We thought you were gone entirely." "Yis, indade," replied Patsy. "Tell me, Patsy," continued his reverence, "when you were so near death's door were you not afraid to meet your maker?" "No, indade, your riverince," naively replied the old man, "it was the other gintleman I was afraid of!"

Scot's Certainty.

Two travelers—an Englishman and a Scotsman—were promenading the deck of an ocean liner, when their talk came to be about the ubiquity of Scotsmen as ship engineers. "I really don't know," remarked the Scot, "who the chief engineer on board this vessel is, but I'll bet he's a countryman of mine." With that he went to the engineroom and sang down by way of a random shot—"I say, MacDonald!" To which a resentful voice replied from the torrid depths—"There's nae Macdonalds here—we're a' MacKenzies and MacGregors!"

What He Said.

"I understand that you called on the plaintiff. Is that so?" "Yes," replied the witness. "What did he say?" The attorney for the defense jumped to his feet and objected that the conversation could not be admitted in the evidence. A half hour's argument followed, and the judges retired to their private room to consider the point. An hour later they filed into the court room and announced that the question might be put. "Well, what did the plaintiff say?" "He weren't at home, sir," came the answer, and a silence fell upon the court room.

His Feet Were Big.

He was a stout man, and his feet were big in proportion. He wore stout boots, too, with broad, square, sensibly-shaped toes; and when he came into the boot shop to buy another pair, he found he had some difficulty in getting what he wanted. A dozen, two dozen, three dozen pairs were brought and shown him. "No, no; square toes—must have square toes," he insisted. "But, sir, everybody is wearing shoes with pointed toes. They are fashionable this season." "I'm sorry," said the stout man gravely, as he got up and prepared to leave the shop—"I'm very sorry to have troubled you, I'm sure. But, you see, I'm still wearing my last season's feet?"

Not a Tiger's Glare.

The most thrilling moment in my life was a fright which I received in a coal pit. I often worked on Sundays at clearing falls and setting wood. One Sunday I was sent to a section to clear away a fall. On reaching the site of the fall I found, to my surprise, a pair of sparkling eyes staring me in the face and glittering in the lamplight; then I heard a scuffle and a snuff. That was enough. A cold, icy feeling seized me. The sweat stood on my forehead. I turned and walked back again, fearing every minute to be caught by some unknown monster from behind. I reached the bottom, and told my story to the "gaffer," who with another man and myself went back to ascertain what it was. To our great surprize we found a horse standing. It had been allowed to move about, and somehow had got fixed in the workings.

Have Courage.

If you are on the gloomy line,
Get a transfer;
If you're inclined to fret and pine,
Get a transfer.
Get off the track of Doubt and Gloom,
Get on the Sunshine Train, there's room,
Get a transfer.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXV. 114 Liberty Street, New York, July, 1912. No. 7

On the Chicago, Milwaukee & St. Paul.

The opening of the summer travel last month marks a new era in the history of the Northwest. Never before has such a stream of tourists passed ing into great popular favor. Travel by this route is uninterrupted from Chicago to Seattle and Tacoma. Two new magnificently equipped steel trains, "The Olympian" and "The Columbian," route is shortened since the completion of the new steel bridge, shown in the illustration, which crosses the Mississippi between St. Paul and Minneapolis, no change now being necessary

"THE PIONEER LIMITED" ON SHORT LINE BRIDGE BETWEEN ST. PAUL AND MINNEAPOLIS, MINN.

from Chicago westward. New through routes have been established that vie with each other in the pleasures and advantages of superb train service. Among the more recent and finely equipped passenger service the Chicago, Milwaukee & St. Paul Railway is com- leave Chicago every day, and in three days the traveler is on the Pacific coast. Between Chicago, St. Paul and Minneapolis the route of the new trains is the same as that of the "Pioneer Limited," through Milwaukee and along the banks of the Mississippi River. The at that point or at any point either by the St. Paul or Omaha routes.

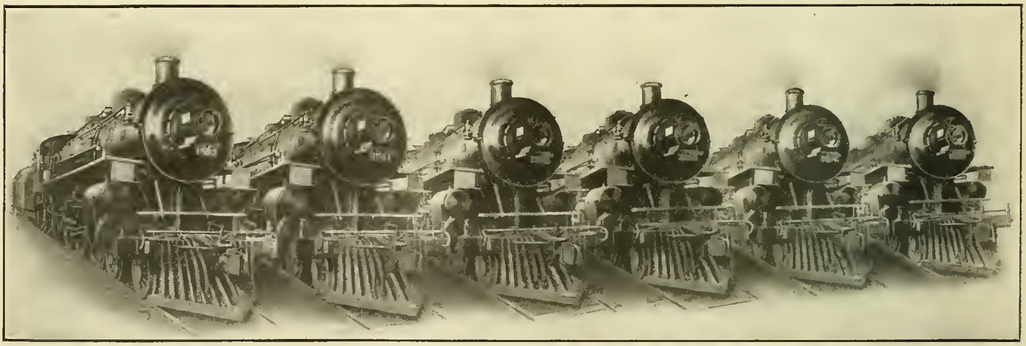
The locomotives, of which there are 1,270 coal burning and 30 oil burning, are nearly all of recent construction, a large number being added during the present year. The trains are steel con-

structed from end to end, and are the first of their kind running between Lake Michigan and the Pacific ocean.

Of the 7,512 miles af track already in operation, the roadbed will compare favorably with the best of the Eastern roads. Numerous steel bridges span the many rivers crossing the route, the most notable being a new steel bridge across the Missouri at Mobridge, ninety-eight miles west of Aberdeen, S. D. At this point the railway joins the Chicago, Milwaukee & Puget Sound Railway. This bridge has three spans of 425 ft. in length. The piers are of solid masonry and rise 55 ft. above the river. The bridge structure rises 65 ft. above the rails. It is the heaviest and most substantial bridge that has been built across the Missouri River.

Apart from the direct and rapid route to the Pacific coast, to which we have already alluded, there is a network of branches covering Northern Illinois, Iowa, Wisconsin, Minnesota and South Dakota, besides extensions that run into Missouri and Northern Michigan, a territory larger than the New England States with New York and Pennsylvania added. In point of fertility and mineral wealth this vast region will compare favorably with any portion of the United States, and much of the development already accomplished is owing largely to the transportation facilities afforded by the comprehensive railway system which has opened up to civilization this vast domain.

We cannot close this brief description of this young, but great and growing railway without again alluding to the splendid facilities for overland travel afforded by the powerful and elegant equipment. The compartments, drawing rooms, bath rooms and lavatories have all the luxurious comforts of a high-class hotel. The culinary department is of the best. The service is perfect. In brief, in the building of the new line it may be truly said that there has been provided for the traveler all that a superlative regard for the comfort, convenience and safety could conceive, in addition to which the travelers who have eyes for scenic grandeur have before them a moving panorama such as seldom falls to their lot anywhere else on earth.



SIX OF THE CHICAGO, MILWAUKEE & ST. PAUL LOCOMOTIVES READY FOR THE ROAD.

Large and Small Cylinders.

High pressure steam performs a given measure of work with much less cylinder capacity than what is practicable with steam of low pressure. Increasing the diameter of the cylinder adds rapidly to the extent of rubbing surface, which causes loss of useful effect by increasing frictional resistance and also increases the area that produces condensation of steam. An ordinary locomotive carrying 100 lbs. gauge and cutting off at 9 ins., will have an average cylinder pressure of 40 lbs. while making 150 revolutions per minute. If the driving wheels are 5 ft. diameter this piston speed will keep a train of the engine's capacity going about 26 miles an hour.

The same locomotive carrying 145 lbs. boiler pressure will average 60 lbs. mean effective cylinder pressure when cutting off at 9 ins. An engine with cylinders 16 ins. diameter will do as much work with 145 lbs. pressure as an engine with cylinders 20 ins. diameter can develop while using steam of 100 lbs. pressure.

Co-operation.

In an address delivered at the Pittsburgh Traffic Club, Mr. Edward T. Jeffery, president of the Denver & Rio Grande, after expatiating upon the wondrous growth of our industries during the past fifty years, attributed the amazing progress to co-operation. "Co-operation," he said, "of our inventive brain and skilled hand; co-operation of brain and brain; co-operation of man and man; co-operation of district and district; co-operation of money with labor and labor with money; co-operation of State with State, of nation with nation; co-operation the world over, and that the closest and most compact in a humanitarian sense as well as of a commercial kind. Could these wonders have been accomplished here and abroad with pulling apart? Would these things have been wrought out without general co-operation, the working together for the general good of which I speak? Were any great things ever accomplished in all the history of the world without the co-operation of great human forces, moral, mental, physical and financial? The keynote of success in these modern days is co-operation everywhere. Co-operation of the shipper and the carrier, the manufacturer and the consumer, the merchant and his customers, district with district, mercantile interest with mercantile interest, carrier with carrier, public authority with public authority, State with State—for the welfare of all and the grandness of the nation at large. Co-operation with the Government by all interests, and by the Government with all lawful interests, equally and fairly and unreservedly."

Popular Knowledge.

Who can tell the exact difference between iron and steel? Who can tell exactly the composition of brass and of bronze? Who can tell the proper ingredients of babbitt metal? Who can tell the composition of self-hardening steel? Who can tell the kind of timber that will carry the heaviest load? Who can tell the kind of timber best suited for posts or piles in wet grounds? Who can tell the best mixture for polishing bright work?

Railway in the Pyrenees.

Three hundred miles of railway being constructed in the Pyrenees are to be operated by electricity furnished by water power stations in the mountains. Constantinople is to be supplied with electricity from a hydraulic power station on the Sakama river, eighty miles distant. There will be two turbine stations, one of 15,000 horsepower and one of 8,000 horsepower.

General Correspondence

Frame Breakages.

Editor:

The question very naturally arises, Why is it that with all of our modern improvements in locomotive construction the number of frame breakages seems to be increasing? With steel frames and finely fitted driving boxes and level tracks there should be a diminution, if not a complete disappearance of frame breakages. Some ascribe it to the rapidity with which even the heaviest kinds of locomotives are driven around the sharpest kind of curves; others blame it to the constantly increasing weight of trains which, of course, place a heavier strain on the frames. If my opinion is worth anything I venture to place the fault on the want of resiliency in the springs. While the springs are increased in the thickness of the leaves as well as in breadth and number, I know from personal experience that they are no longer, in many cases, acting as springs at all, but might as well be made of thick bars of soft iron. Either the quality of the steel is poor, or the space available for springs becoming limited there is not sufficient room for the proper form of spring capable of that degree of elasticity essential to rapid and complete flexibility.

In any event it is remarkable in how short a time the largest springs flatten in their shape, and the first note of danger comes when the driving boxes are striking on the frames, and the springs become worse than useless. It is true that there are new and quick methods of welding frames, but I am convinced that if there were new methods or means of making the springs more elastic and more enduring there would be fewer frame breakages.

I have noted in your columns an occasional allusion to the fact that there are more breakages on the left side of a locomotive than on the right side, and if I remember rightly the matter was very cleverly explained by ascribing to the irregular thrusts made by two pistons attached to crank pins set at right angles to each other, and consequently leaving an irregular vacant space between the thrusts, thereby superinducing an irregular series of blows at some particular point of the successive revolutions.

Doubtless some of your learned and ingenious correspondents may be able to throw some further light on this interesting and mysterious subject. It will be agreed, I think, if the size of springs is to be increased at the expense of frames, it is high time that some new method of flexibly suspending the weight should be adopted to the end that an approach may be made to the older and more durable quality of frame preservation.

J. W. Allan.

Easton, Pa.

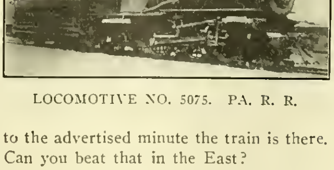
A Wolverine and a Pennsylvanian.

Editor:

Enclosed is a photograph of one of the "Wolverines" on the Michigan Central.

WOLVERINES ON THE MICHIGAN CENTRAL.

Not more than half of the cars are shown as there are seldom less than ten or eleven heavy passenger cars on every train besides the baggage car. This is the fastest through train on the Michigan Central. If you look close enough you will see that it is double headed. In regard to speed, train No. 48, "The Detroiter" from Detroit, makes the run from Windsor, Ont., to St. Thomas, Ont., 109 miles in 104 minutes every night. When the long hand of the station clock comes to the advertised minute the train is there. Can you beat that in the East?



LOCOMOTIVE NO. 5075. PA. R. R.

I enclose a photograph of another flyer which is said to make great time, No. 5075 of the Pennsylvania. She is said to be the heaviest on her drivers that has ever been built, but I am unable to vouch for the claim. One engineer told me "she's a peach, and there isn't an engineer on the road but what isn't crazy to run her." Some of them may be able to give you some particulars about this remarkable locomotive.

C. E. Fisher.

Ann Arbor, Mich.

Steam Gauge Test.

Editor:

It occurs to me that all steam gauges are not registering correct pressure even though they have been tested and found correct, and as it is a very important matter I think it should be given a thorough test at the required time.

The gauge may be taken off and tested with a dead weight tester which is accurate and gauge found to be correct and at the same time the pressure in boiler might be 235 or 240 lbs., when the gauge registers 200 lbs., due to corrosion in the pipe. I had a case where the gauge pointer suddenly dropped 30 lbs., while on road, safety valve would lift at 170 instead of 200 lbs., no change was made in pops. I reported gauge tested and found correct. I happened to be at the shop when they were getting the engine hot to set pops, the pressure was then about 90 lbs., and a man on the engine waiting to give her 30 lbs. more pressure. I started the air pump slowly and lapped the brake valve (having a duplex governor) and pumped a pressure of 110 lbs. of air with 90 lbs. of steam pressure which the gauge registered. Maximum pressure head of governor was adjusted 110 lbs. I then advised the machinist not to adjust the safety valves and went to the other terminal and reported the gauge, thinking there was something wrong with the first test. I did not rest until I learned the result of the second test which proved the gauge again correct. I then had the pipe taken off and found it badly restricted with corrosion. I had pipe cleaned out and cured the trouble.

I know of another case where there were three engines of the same type and size and one of them could not pull the same tonnage the other two could handle on account of cylinders being bored on two of them. The Transportation Department threatened to take the engineer out of service if he was not able to pull the tonnage the other two engineers were handling, and then of course the engineer, not being able to explain to them the cause and did not care to loose the run, got wise and put a copper gasket in the steam gauge pipe at boiler connection with a very small hole in it.

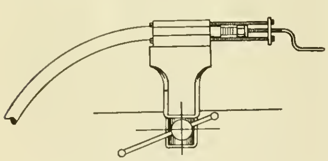
I do not know how much more boiler pressure he had than gauge pressure but I do know that he kept the run and handled the same tonnage the other engineers handled. Now this steam gauge could have been taken off and tested and found correct while the boiler pressure was ex-

cessive or more than it was intended to carry, and for this reason I do not consider the gauge tested unless the pipe is known to be sufficiently open.

In this connection I would suggest that the valve which enters the boiler direct have two additional valves on a "T," one to the steam gauge and the other to be opened to the test gauge when comparing gauges for test. Use an accurate test gauge with siphon pipe, close the main valve and open the two valves to the gauges, then open the main valve a little at a time and note how the gauges tally, and if both gauges correspond I think we would be safe in reporting it correct. However the valve that enters the boiler direct should be cleaned as well as the gauge pipe occasionally.

The test referred to above of course is intended for boilers under pressure and the man that is assigned to this duty could test a dozen hot engines while he is testing one gauge on a cold engine, but the gauge on the cold engine would have to go to the dead weight tester if it was due a test. I would like to have the opinion of some of the readers of your journal in regard to the accuracy of the above mentioned test. F. E. PATTON.

Columbus, Miss.



DEVICE FOR ATTACHING HOSE COUPLINGS.

Devices for Attaching Hose Couplings and Reaming Bell Frames.

Editor:

Attached drawing shows a very handy home-made device for forcing various sized hose connections in place. It consists of two wooden blocks 6 or 7 ins. long with hole bored through them to suit the size of hose. These blocks are held between the jaws of a vise, and the blocks closing together hold the hose securely while the sleeve or hose connection is being forced into the end of the hose by a 5/8 in. screw, as seen in the drawing. As shown there are two bolts that pass through the wooden blocks and are threaded to accommodate the distance required in inserting the coupling. The screw operates in a crossbar slidably engaged on the two bolts. Any one trying this device will discover that it soon pays for itself.

The other drawing shows a bell frame reamer which is used to ream the worn holes in the bell frame without removing the frame from the boiler, which would have to be done if a tool of this kind were not used. This tool consists of a simple 3/4 in steel arbor squared on one end to receive a wrench or turning handle, and the other end adapted to fit various sizes of shell reamers, which vary in sizes by 1/32 in. A steel cone fits over this arbor and is held in place in the opposite hole in the frame by a coiled spring, one end of the spring resting on the cone and the other end resting on an adjustable collar held in place by a thumb screw, as shown in the drawing. The cone has the effect of holding the bar in perfect line while reaming one hole, and when this operation is finished the tool is reversed and the other hole reamed in the same manner. The holes will be found to be in perfect line, with little labor, which means small cost. It need hardly be added that the fluted cutting reamers are tapered at their points. They are 3½ ins. in length, by about 1½ ins. in diameter, with 14 flutes, and are slidably engaged to the arbor by two dowel pins attached to the arbor and adapted to fit into two recesses in the reamers.

CHAS. MARKEL,
Shop Foreman,
C. & N. W. Ry.

Clinton, Iowa.

Why Flues Leak.

Editor:

I am a fireman and do not claim to know much about locomotives. Firemen have no license to know very much, but I have been keeping my eyes open, however. Last year I fired in Texas, where the water is bad, it is bad enough so that engines only run three hundred miles before boilers are washed out. I fired for two different engineers. The first one was eternally having his flues calked, and I seldom saw the engine go over the division without leaking. Almost all the engines were the same way, and I came to the conclusion that it was a hard country on boilers, and it is. Finally I got changed off to another engine with a young engineer. The day I was marked up my old engineer remarked: "Going out with the kid, are you? Well, he's a pretty good fellow, and may make an engineer in time." I went out expecting to have a hard trip.

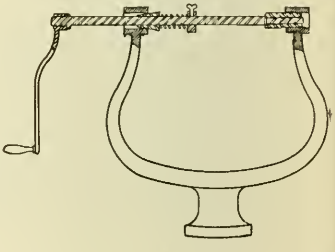
When I came to the engine in the yard the engineer was there. We talked pleasantly till the time came to start. He was no older than myself, and had been promoted there. As we coupled onto the train, he turned to me and said: "Don't think I am a crank, but I never talk when running, I am busy." I like that.

We pulled out a heavy train, and as soon as the engine "popped" the kid runner put on the injector; I fired carefully and the engine steamed well; I kept watch of the water in the gauge glass, and it seemed to stand at one point. The kid watched it, too; I noticed on hard pulls he touched the lazy-cock handle, and when the road became level again, and the throttle had to be eased off, he eased off the lazy-cock, too. We stopped for water, and side-tracked for the express. He tried his water as he shut off, had a flutter in the top gauge and solid water in the second. He let the injector work till we got in siding and shut it off, and told me to open the door.

My old engineer never touches the lazy-cock. He works the injector full until the glass is full, or it commences to rain, and then shuts it off. Of course, I have to keep a big fire when it is on full. As soon as it is shut off the pop commences to throw steam and the stack water, then I open the door to cool her down, then the fire gets low, so does the water, and on goes the "squirt." Then I have to hustle, then the flues leak.

I was with the "Kid" two weeks, and the flues did not get hammered once. It is down-grade for over forty miles into headquarters, and sometimes the flues would simmer all over, but not squirt. The "Kid" always looked at them and said: "They will take up with a new fire; I don't want them rolled unless they squirt, it only makes them thin and weak."

I asked the boss boilermaker about it,



DEVICE FOR REAMING BELL FRAMES.

and he said he didn't see how the "Kid" did his work. Every other boiler was doctored a dozen times to his once, said the M. M. was speaking about it the day before.

I came to the conclusion that the "Kid" will not have to wait for time to make an engineer of him. I came to the conclusion that he is one of those men who think about their work, and I found myself trying to fire better to keep up with his intelligent running, and I would have been firing for him yet if I had not been smart and coupled the engine to train for a lazy brakeman and coupled onto a pair of fingers. ROBERT WILSON.

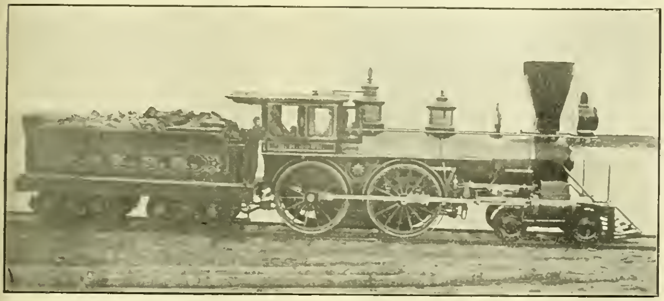
Dallas, Tex.

Some Famous Maine Engines.

Editor:

Wm. Mason built for the P. & K. in 1864 two freight engines, No. 14, the "Wm. Sewall," and No. 15, the "Kennebec." These engines were the first turned out by him, with a wide bell yoke, and they were so equally matched that one could haul no more cars than the other.

Their cylinders were 15 ins. x 22 ins. and drivers 5 ft. How proud the "Kennebecers" were of them! Smart? Well, just ask some of the old boys. For years their crews tried to prove that they could outpull each other. They tried it many times, but a load one could wiggle over the bunch would be duplicated by the other. This rivalry became so keen that in starting west out of Brunswick they would hook on to more than they could top the hill just west of Brunswick with, and used to back down the Bath branch a distance to get a run.



LOCOMOTIVE NO. 20. PORTLAND & KENNEBEC R. R. "H. N. JOSE."
Built at the Portland Company's Works, Portland, Me.

These engines pulled freight on the P. & K. and M. C. R. R. till crowded out by much heavier machines, and were put on branch runs, and about 1893 were broken up. If you want to hear of some remarkable pulls just start some of the old-timers going on what the "Sewall and Kennebec" could do. Not all Maine engines were extra smart, of course. I am writing only of those that proved their mettle. There were many engines on Maine roads that would be of no interest to judge by their performances, but it's well that the best of the old-timers should receive more than passing notice, and the engines illustrated were worthy of praise.

The Portland & Kennebec had a variety of peculiar old engines, built in the late 40's and 50's, the most of which were inside connected. They tell many remarkable tales of two of them. One was the old "Revel Williams," built by Hinkley in 1853, and all the old runners claim that she could outrun anything on wheels. When I broke into the railroad game the old "Williams" was a switcher, and although I have made several trips behind her when our regular machine was off for minor repairs, never saw her opened up for speed.

The old "Jose," illustrated herewith, I can vouch for. She was a product of the Portland Company, built in 1870, and was of a very pleasing model and decorated with brass and paint. Her cylinders were 15 ins. x 22 ins., and drivers 66 ins., weight about 35 tons. She shows a vast improvement in design over the old machines, and this model was standard with the Portland Company until about 1888.

Counterbalancing from hub outwardly had not gone completely out of fashion at this time, as can be seen by the rear driver. The "Jose" hauled their heaviest passenger trains for about seven years, then branch trains. She was one of the fastest engines the writer ever worked with; could pick up a train very quickly, and when main line connections were late and the engineer had a chance to let her out, how her drivers would purr! She ran until 1894, and with a lot of other old-timers was sold to the Sch. Loco. Co. and broken up.

The best all-round locomotive of anywhere near her inches the M. C. R. R. Co. ever owned was the "Arthur Sewall," No. 64. She was built at the Portland Co. Works in 1877, with cylinders 16 ins. x 24 ins., and drivers 4 ft. 8 ins. When ready for the road she weighed 49 tons. She could get two cars more over the hill than the "A. D. Lockwood," the old "Queen of the Road," and for speed nothing in the State of Maine could touch her.

Previous to the "Sewall" there had never been but one engine in "Back Rout" service that could compete with the Grand Trunkers for speed. This was the old "Union," a Baldwin machine. The G. T. had a lot of Baldwins, all very fast, and they used to race over that stretch of road between Danville Junction and New Gloucester, where roads run side by side.

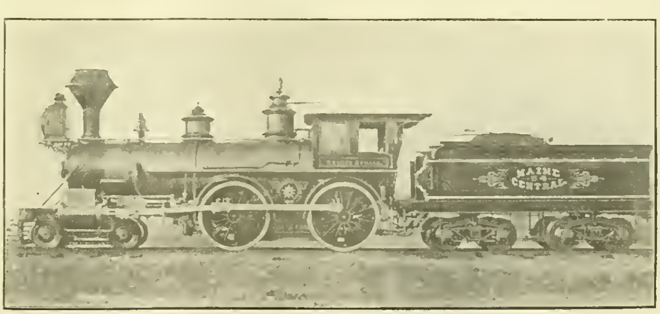
After the "Sewall" was put on this run the Grand Trunkers gave it up. They couldn't touch her.

They gave her the name of "Black Maria," and let her severely alone. No amount of coaxing would induce them to give her a try. This was the last named engine built for the M. C. R. R. Although fancy decorations were going out of fashion she was quite a showy engine when first built, but her brass work was soon covered up with black paint, hence her nickname. This old engine handled all their best passenger trains, was on all the heaviest freight runs, and was liked by all the boys. It was well along in the 80's before another engine was built that could compete with her, and it took a much heavier engine to down her.

Heavier engines coming in, in the late 90's she was disposed of, but whether she is still on the rails I do not know.

Her two mates, the "Philander Coburn" and the "Wm. G. Davis" are still in harness, although they are now owned by other roads.

When the old "Jose" was in her prime nearly all the Maine Central locomotives burned wood. At every station you would see enormous woodsheds, open on the side, piled full of wood. To saw this enormous quantity of wood, that the old wood burners used to eat, they had regular sawing machines, so arranged that they could shift the gear and propel themselves from station to station. The crews lived in a house car, the foreman acted as conductor, and usually the wife of one of the crew went with them as cook.



LOCOMOTIVE NO. 64. MAINE CENTRAL R. R. "ARTHUR SEWALL."
Built at the Portland Company's Works, Portland, Me.

How queer they would look traveling over the rails of a modern road, hauling the house car and a flat car which carried their wood and water. Their speed was about 4 miles per hour. The engine weighed about 6 tons. Only one pair of wheels were used for drivers, and they must have had a hard pull over some of the hills.

CHAS. S. GIVEN.

Bowdoinham, Me.

Fancy Penmanship on Train Orders.

Editor:

At rare intervals the press of the country records a fatal calamity resulting from a misunderstanding of train orders.

Train orders, as a rule, are not carefully enough read. Train orders are not carefully enough written. A fatal collision recently occurred where the conductor read Somersett for Summit. They may have been caused by poor or fancy penmanship, or poorer attention in reading. Many operators try to see how many flourishes and how much fringe they can work on to a train order, and the idea should be sat down on by the train men.

The writer was one of the star performers in a little circus of high and lofty tumblers caused by an operator giving an order where "2nd section number 29," was made to look like "and number 29." First 29 was the ringmaster that made all hands hunt for plowed ground.

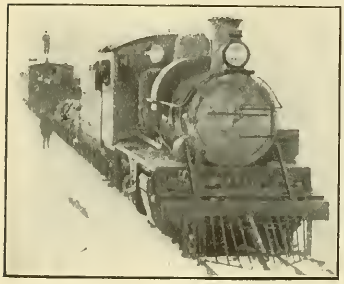
Too much care in writing and reading train orders cannot be used.

The writer has often thought that some system of orders where the conductor or the engineer had to write the body of the order himself and have it "O. K'd." or "corrected" by the operator would prevent mistakes in reading and understanding orders. Its greatest disadvantage would be that it is a slower process than that now in use.

There are now in successful operation several systems of receiving and sending telegrams on moving trains, and in this case the order received could be written by the conductor if necessary.

Mistakes and blunders in this line are calling for many victims per year, and means should at once be taken to cut down the death-roll.

Philadelphia, Pa. A. MACLAY.

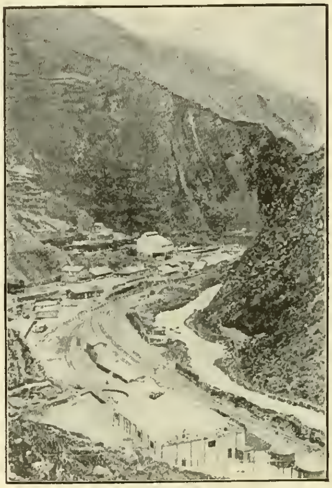


HIGHEST POINT ON CENTRAL RY. OF PERU.
15,865 feet above sea level.

On the Railroads of Peru.

Editor:

The ancient home of the Incas is coming more prominently into notice, as the increasing tourist traffic shows, and there are many peculiarities in railroad engineering that are a surprise to those of us who have been in many lands and who are accustomed to looking upon South America as being in its infancy in railway development. It is not necessary to dwell on the scenic wonders of this strange land; suffice it to say that there is no land more richly endowed by Nature with everything that is more magnificent to the eye of the traveler, none whose history is more fascinating, or whose relics of a former age are more potent to cast a spell over the imagination, than Peru. Here are the ruins of a great empire, and here a handful of daring Spaniards subjugated an entire nation. The resources of the country are amazing.



RIO-BLANCO REPAIR SHOPS. CENTRAL RY. OF PERU.

Callao is the principal city, readily reached by steamers from Panama. It is the center of a very important shipping business, and here the railway begins that leads to Huancayo, 217 miles, on the Atlantic side of the Andes. The road rises steadily from sea-level with an average grade of 4 per cent., much of it through solid rock, to its highest point at Ticlio, 15,865 feet above sea-level, about 1,000 feet higher than Pike's Peak. There are in all 65 tunnels and 67 bridges, all of them marvels of construction. There are 16 switchbacks, and the largest copper mines in the world, at Cerro de Pasco, are at an altitude of 12,178 feet. The country is gorgeous with its many lakes and glaciers. The vegetation in the valleys is of a dazzling brilliance. It is without exception not only the highest but the most beautiful railway in the world. The sublime grandeur of the scenery met with in these high regions baffles description. It is interesting to note that this extraordinary ascent is made without the use of a single foot of rack line. On the downward journey the passenger trains are piloted by a hand car, equipped, as is the whole of the rolling stock on the railway, with the most powerful brakes, and running by gravity the whole distance.

The locomotives are nearly all of the British type, with inside cylinders; the gauge is standard 4 ft. 8½ ins. wide, and the equipment generally is excellent, and the railroad fare is a little less than that of the United States. Many British engineers and machinists are to be met with, and quite a few Americans, and all are seemingly prosperous and much respected by the natives. I was much pleased to note that RAILWAY AND LOCOMOTIVE ENGINEERING is much in evidence among the leading railway men, and I am sure if a Spanish edition could be furnished it would meet with great popular favor, as everybody, even foreigners, speak and read Spanish. The past of Peru must have been splendid, the present is full of achievement, and the future will be great.

New York, N. Y. L. LODIAN.

Turning Piston Rings and Idler Brasses.

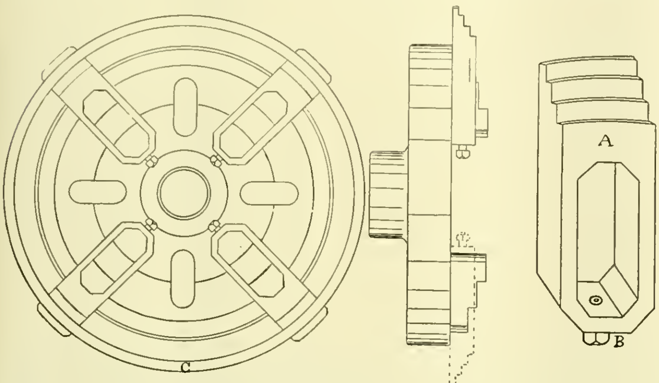
Editor:

A very useful device is in service in the machine shops here for the purpose of turning piston rings to proper size, and also avoids straining them in any way. As shown in the accompanying drawing, it consists of adjustable bearers stepped to different sizes, the sliding bearings being adapted to fasten on an ordinary lathe. Refering to the drawings it will be noted that A is a special bracket on which steps are arranged to receive different sizes of rings. There are four of these brackets. B is a set screw for fastening, and C is the ring ready for turning.

A SWITCHBACK. CENTRAL RY. OF PERU.

The other device is used for turning the idler brasses on 4-6-2 or Pacific type of locomotives with suitable tool. A is a mandrel. B is the fastening clamp. C is the brass in place for turning, and D is the tool in position .

Montreal, Canada. J. G. KOPPELL.



DEVICE FOR TURNING PISTON RINGS.

Railroad Commissioner on Relations of Capital and Labor.

At an annual meeting of the Traffic Club of Pittsburgh, the Hon. Chas. A. Prouty, chairman of the Interstate Commerce Commission, delivered an admirable address, part of it devoted to the relations of railroad capital and labor, which we quote as follows:

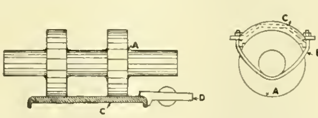
In the upper stratum of society small progress has been made in the last twenty-five hundred years. Men of the highest intelligence think no better, express themselves no more clearly, live generally in no greater comfort than in the days of Socrates. But in the lower strata the greatest improvement has occurred; and nowhere is the condition of the laboring man probably as good on the whole today as in this land of ours. It is most significant that the English miner is demanding a minimum wage of $1.25 per day, while the anthracite mine workers demand $2.75, if I remember that figure correctly. Even so, it is doubtful whether the laborer yet obtains his proper share of the value of the product which he produces, and if you can show me any way by which he can be given a greater share, or by which what he earns can be made to maintain him in greater comfort than now, I, for one, stand for it.

I believe in organized labor. Capital is of necessity organized, and labor must also organize if it would cope successfully with capital. But combinations of labor, like combinations of capital, are in the nature of monopoly and may be tyrannical and oppressive.

No form of labor is more highly organized than railway labor in certain classes, and the very fact of this more perfect organization has enabled that labor to secure excellent compensation in comparison with other forms of labor. I do not intimate that railroad wages are too high, for I have no thought of that sort.

Suppose organized railway labor makes a further demand for increased wages, and that the railroads accede to this demand. The increased wage adds to the expense of operation and reduces net revenue. The railroad applies to the Interstate Commerce Commission for leave to advance its rates on this account. What now is to be the answer of the commission?

The railway rate is paid by the whole body of the public. If, therefore, this increase in wages was unjustifiable, and if on that account an increase in rate is allowed, it results that the general public, including all other forms of labor, is required to pay what is unreasonable.



DEVICE FOR TURNING IDLER BRASSES ON PACIFIC TYPE OF LOCOMOTIVE.

Must not, therefore, the government be satisfied, not only that the added wages are paid by the railroads, but that they are necessarily and properly paid? And is not the railroad thus placed in a most unfortunate and embarrassing dilemma?

Consider this matter for a moment now from the public viewpoint. It was recently suggested that certain demands would be made by railroad labor in a certain section of this country, which would be supported, if not complied with, by a general strike of all classes of trainmen. Such a strike would be altogether possible today. Think for a single moment of the consequences: suffering, riot, death must result. Ought not the public to protect itself against the consequences of such possible action?

We have the Erdman Act, and this has given most admirable results; but that is a peace-measure obligatory upon no one, and of no value in time of war. I have believed that it would finally be found necessary to provide by federal enactment that no strike shall be declared by organized labor upon any interstate railroad until the question at issue has been submitted to arbitration, and a certain length of time has intervened after the award, and after notice that the strike would be inaugurated notwithstanding the award. It is doubtful if we could compel either the railroad or the employees to comply with the award, but certainly in view of the stake which the public has, the government may require of the railroad as its servant upon one hand, and of organized labor, as a condition of its organization upon the other, that the use of these public facilities shall not be interrupted until every attempt has been made to avoid that necessity.

Probably neither party would approve such legislation. The railroad manager would say that every arbitration means a compromise that he must as a matter of fact, although nominally a free agent, comply with the award, which is probably true, and that, therefore, you take out of his hands the management of his property.

The employee would object because he is thereby to an extent deprived of a weapon of offence in the enforcement of his claim, and since it would be difficult for organized labor to enforce a strike against public opinion in case of an adverse decision.

But is it not after all for the interest of all parties that these questions should be settled by peaceful methods rather than by the waste, the misery, the possible bloodshed of a great strike, and is it not better for both parties that the government should have sanctioned the increase if one be made, and must, therefore, of necessity sanction the increased rate with which to meet it if need be?

Business.

The situation in brief is thus summarized by the United States Bureau of Railway Economics: Returns for March, 1912; reduced to a mile basis and compared with the returns for March, 1911, show an increase in total operating revenues per mile of 3.9 per cent., and an increase in operating expenses per mile of 6.0 per cent. Net operating revenue per mile decreased $3, or 1.1 per cent., from March, 1911. The net operating revenue per mile for March, 1911, was 12.8 per cent. less than for March, 1910.

The prospects for 1912 are more promising, so that the return of a large operating revenue is generally assured.

Type of Mallet Articulated for the Lake Terminal Railroad

The rapidly growing requirements of hump yard and terminal switching service have recently necessitated the introduction of locomotives capable of developing exceptionally high tractive force. Where the necessary tractive force cannot be developed by a ten-coupled locomotive, an articulated design must be used. Such a locomotive has been recently built by the Baldwin Locomotive Works for service on the Lake Terminal Railroad at Lorain, Ohio. This engine was specially designed to push trains of loaded ore cars from the docks on the lake front to the mills of the National Tube Company. The run is short, but the requirements are severe, as the maximum grade on straight track is 1.65 per cent., and immediately after starting, a curve of nearly 8 degs. must be traversed, in conjunction with a grade of 1.23 per cent. The locomotive is fully capable of handling the specified load of 21 cars, weighing 78 tons each, or a total of 1,638 tons. It is of the 0-6-6-0 type, and is equivalent in capacity to two of the 0-6-0 type switchers formerly used in this service.

In many Mallet locomotives it is necessary, in order to carry a boiler of sufficient size, to use leading and trailing truck wheels. If, however, the run is short, and the track conditions permit, all the weight may be carried on the driving wheels, and at the same time ample boiler capacity can be provided.

In the Lake Terminal engine the ratio of heating surface, in square feet, to the tractive force, in pounds, is as 1 to 14.6. This type of locomotive develops a tractive force of 82,500 lbs. The weight on the driving wheels is 350,100 lbs., the ratio of adhesion consequently being 4.25.

The height over all was limited to 14 ft. 9 ins., and this necessitated locating the bell and sand boxes on the round of the boiler. The sand boxes are four in number, and the bell is placed on the left-hand side. The cylinders are all cast separate from their respective saddles. The high pressure saddle is made in two pieces, placed one above the other. The upper piece, which is compartively small is riveted to the boiler shell. The lower piece is extended back to the cylinders, and to it the cylinder castings and rear frames are directly bolted. In each case a slab fit is secured, with a large bearing area; and the keys are driven home in pairs, in a vertical key-way with their tapered faces in contact. The lower section of the saddle is cored out to form a seat for the ball joint of the receiver pipe. The center line of the ball joint coincides with the hinge pin center, so that the length of the receiver pipe remains constant when the locomotive is traversing curves. The lower saddle section also takes the hinge pin, which is 6 ins. in diameter. This pin is inserted from beneath, and is held in place by a supporting bolt.

The boiler is supported, on the front frames, by a single bearer which is placed between the second and third pairs of driving wheels. The front bearer has a clearance of ½ in. between the upper and lower castings, and normally carries no load.

The steam distribution to all the cylinders is controlled by balanced slide valves, which are driven by Walschaerts motion. The valves are all set with a lead of ¼ in.

This locomotive, although not of exceptional size, is of special interest because of the details of its construction and also because of the conditions under which it is operating. Preliminary trials indicate that it will prove entirely capable of doing the work required.

The following are the principal dimensions of this type of locomotive:

Gauge, 4 ft. 8½ ins.; cylinders, 24 ins. and 37 ins. x 32 ins.; valves, balanced slide.

Boiler—Type, straight; material, steel; diameter, 84 ins.; thickness of sheets, 15/16 in.; working pressure 205 lbs.; fuel, soft coal; staying, radial.

Firebox—Material, steel; length, 117½ ins.; width, 96 ins.; depth, front, 78 ins.; back, 74½ ins.; thickness of sheets, sides, ⅝ in.; back, ⅜ in.; crown, ⅜ in.; tube, ½ in.

Water Space—Front, 6 ins.; sides, 5 ins.; back, 5 ins.

Tubes—Material, steel; thickness, No. 11 W. G.; number, 437; diameter, 2¼ ins.; length, 21 ft. 0 in.

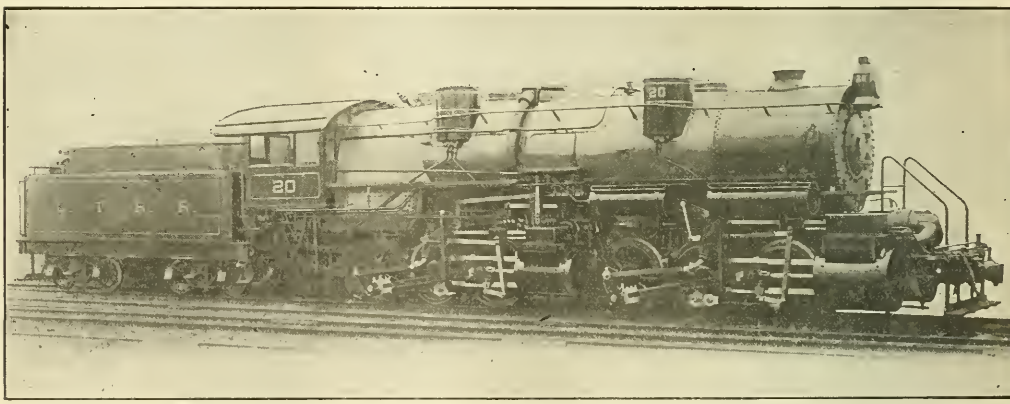
Heating Surface—Firebox, 230 sq. ft.; tubes, 5,380 sq. ft.; firebrick tubes, 30 sq. ft.; total, 5,640 sq. ft.; grate area, 78.3 sq. ft.

Driving Wheels—Diameter, outside, 55 ins.; diameter, center, 48 ins.; journals, main, 10½ ins. x 12 ins.; journals, others, 10 ins. x 12 ins.

Wheel Base—Driving, 29 ft. 8 ins.; rigid, 10 ft. 0 in.; total engine, 29 ft. 8 ins.; total engine and tender, 62 ft. 2¾ ins.

Weight—On driving wheels, 350,100 lbs.; total engine, 350,100 lbs.; total engine and tender, about 480,000 lbs.

Tender—Wheels, number, 8; wheels, diameter, 33 ins.; journals, 5½ ins. x 10 ins.; tank capacity, 7,000 gals.; fuel capacity, 12 tons; service, switching.



MALLET ARTICULATED LOCOMOTIVE FOR THE LAKE TERMINAL RAILROAD.

G. N. Riley, Superintendent of Machinery. Baldwin Locomotive Works, Builders.

M. C. B. and M. M. Conventions Reports

M. C. B. and M. M. Conventions.

The forty-sixth Annual Convention of the Master Car Builders' Association, and the forty-fifth Annual Convention of the American Railway Master Mechanics' Association were held at Atlantic City, N. J., the former on June 12, 13 and 14, and the latter on June 17, 18 and 19. The attendance was large and the proceedings were of the usually interesting kind. President A. Stewart, general superintendent of motive power of the Southern Railway, presided at the meeting of the Master Car Builders' Association, and in the absence on account of illness, of President H. T. Bentley, assistant superintendent of motive power and machinery of the Chicago and Northwestern Railway, Vice-President D. F. Crawford, general superintendent of motive power of the Pennsylvania Lines, presided at the meeting of the Master Mechanics' Association. The secretary of both associations, Mr. Jos. W. Taylor, Chicago, read the annual reports which had already been submitted and approved by the Executive Committees, and were afterwards unanimously endorsed by the members of the Conventions.

It was gratifying to observe the increased interest in the discussions on the reports of the various committees who were intrusted with the important technical subjects submitted to them. The discussions on these subjects were more than usually interesting, and in this regard the marked improvement in the readiness of debate, in the fluency and eloquence of language, in the gentlemanly decorum, added to the weight and importance of the subjects discussed, were the best proof, if proof were necessary, that meetings of this kind are not only of great value in bringing in concrete form the best expression of the best thoughts in regard to the multiplex questions affecting the mechanical problems that confront railway men, but they are also of still greater value in the molding of the characters of the men who participate in them. Of course, the railroad clubs aid in this good work, while the better and higher education within the reach of all render the meetings, as we have said, of growing value and importance year by year.

The object lesson of the exhibits that surround the meetings is in itself of immense educational value. While it may be truly said that we stand on the shoulders of those who have gone before us in every department of human endeavor, it is nowhere more conspicuous than in the realm of railway machinery. Probably the most remarkable feature of the machinery in operation at the exhibition was the rapidity of movement of the most ponderous machines. This, of course, has been made possible by the marked improvement in the manufacture of tool steel and the railway men owe much to the earnest and able men whose experiments have resulted in revolutionizing the possibilities of metallic alloys, and the methods of production. Even the setting of the exhibits has improved by experience. It is one thing to see even a fine machine in a crowded machine shop in operation under conditions that are not always of the best, and another thing to see it in burnished beauty among a cluster of red geraniums, white alyssum, and blue lobelias. All the blossomed glories of June were there in rich profusion. Vari-colored rugs and glowing tapestry were in abundance. The furnishings were superb, and if we add to this the repeated blasts of warbled melodies from a band of skilled musicians that made the balmy air vibrant with airs familiar to the memory, while underneath and around the low wash of the ever restless sea made scenes and sounds alike pleasing to eyes and ears.

It was no mere holiday excursion, however, that the master car builders and master mechanics were engaged in. They were there on business, and it becomes us, as journalists engaged in the same calling, to present as far as space will allow us a condensed report of the most important subjects presented and discussed by them. As already noted the reports showed how carefully the various committees had considered the subjects with which they were entrusted, and some knowledge of the value of their work may be gathered from the following abstracts of the reports and discussions presented:

M. C. B. Reports

Car Wheels.

Mr. Wm. Garstang, Sup. M. C., Cleveland, Cincinnati, Chicago & St. Louis Railway, chairman of the committee on car wheels, reported at considerable length on the subject presenting a detailed report of a joint conference between the members of the committee and a number of makers of steel wheels. The meeting was held at Pittsburgh last December, and the work of the committee fully explained to the manufacturers, with the result that the American Society of Testing Materials are now working jointly on designs and specifications for steel wheels. The committee expressed an opinion that the art of manufacturing solid steel wheels is yet in process of development, and thought it unwise to recommend a standard specification at this time, governing the quality of the material or the method of manufacturing solid steel wheels.

A number of recommendations have been submitted to the committee by the Association of Manufacturers of chilled car wheels, but only a few of the recommendations were approved. These referred chiefly to matters of dimensions, and some of them were not practicable, such as increasing the thickness of the wheel flanges, and indenting the wheels 3/16 in. further apart. As this would involve clearances in frogs and crossings. it was suggested that the question be referred to the American Railway Association.

Tests of Brake Shoe Equipment.

The Committee on Brake Shoe Equipment, of which Professor Chas. H. Benjamin, Purdue University, Lafayette, Ind., is chairman, presented a lengthy report, showing that numerous experiments had been made in the testing of brake shoes, as well as considering the subject of brake-beam standards, and recommended that further tests be made on the shoes tested last year to connect the results with those previously obtained, the tests to be made at a speed of 65 miles per hour, and at pressures ranging from 12,000 to 18,000 pounds.

In regard to brake beams, the committee recommended that all brake beams shall be 60¼ ins. in length from center to center of brake head, with a maximum allowable spacing of 60⅜ ins., and a minimum of 60⅛ ins.; this spacing to be measured by gauging inside of the brake head key lugs.

A drawing of a new brake beam gauge was submitted, with a view of adopting such gauge, as recommended practice to take the place of the gauge at present in use.

Rules for Loading Materials.

Mr. A. Kearney, assistant S. M. P., Norfolk & Western Railway, Roanoke, W. Va., reported on the subject of Rules for Loading Materials. Among the recommendations was the adoption of the methods in use on some of the Canadian roads, having flat cars equipped with permanent chains and short stakes, which are used for the handling of logs. This subject came up last year, but was too late for adoption.

Improvements in the method of loading mounted wheels on flat cars were suggested, and illustrations were given of the committee's suggestions. The best method shown consists of having three pairs of wheels at either end of load tied together, using ¾-in. rods with clamp plates or ¾-in. U rod and fastening plates, and blocking at ends and along sides, of hardwood not less than 4 by 8 ins., joined and bolted to car floor.

The committee reported that they had received a great deal more assistance during the past year than heretofore, and expressed an assurance of the increased usefulness of their work in the future.

Specifications for Freight Car Truck Sides and Freight Car Truck Bolsters.

The committee on the above subject, of which Mr. E. C. Schmidt, of the University of Illinois, was chairman, presented an able report on the subject, giving complete specifications for these structures for freight cars of 80,000, 100,000 and 150,000 lbs. capacity. The committee dealt only with cast steel structures, and the report covered the physical and chemical properties of the material. Among other details the committee recommended that the chemical composition of the steel should conform to the following requirements:

Carbon.. from 0.20 per cent. to 0.30 per cent.
Manganese........not over 0.70 per cent.
Phosphorus.......not over 0.05 per cent.
Sulphur..........not over 0.05 per cent.

Tentative specifications for stated tests of the complete truck ride were submitted. These embraced a description of the supporting of the truck side at each end of the testing machine, directly beneath the center line, which corresponds to the center of the axle, the load to be placed on the center of the bolster, and the allowable deflection to be measured at that point. The truck side should be subjected as stated in the following table:

For cars of	Initial load, pounds.	Proof load, pounds.	Maximum deflection.
80,000 lbs. capacity....................	20,000	135,000	⅛ in.
100,000 lbs. capacity	25,000	160,000	⅛ in.
150,000 lbs. capacity....................	35,000	210,000	⅛ in.

Markings were also recommended including the initials of the railway company, the date of casting, the serial number and trade mark, and the letters M. C. B. S.

Springs for Freight Car Trucks.

The Committee on Springs for Freight Car Trucks, of which Mr. W. F. Kiesel, Asst. M. E., Pennsylvania Railroad, Altoona, Pa., reported progress, and made some pertinent comments on the subject, submitting general statements that springs now used have too little range of deflection, and sometimes break in service. Experiments are being made by manufacturers with a view of developing the use of more reliable material and more uniform temper. Relief is expected by heat treatment of steel and careful tempering, which will permit the use of higher stresses when springs are compressed solid.

The steel at present used has about 1 per cent. carbon, and when springs are compressed solid the stress is between 80,000 and 85,000 lbs per sq. in. With carefully tempered, heat-treated steel, this stress can be increased to 100,000 lbs. per sq. in., and possibly to 120,000 lbs. per sq. in. without producing permanent set or breakage, and the resultant decrease in diameter of wire will give a greater range of deflection within the limited space now available in trucks.

A change was recommended in the design of the spring caps, and a series of physical tests of springs was also recommended.

Train Lighting.

Mr. T. R. Cook, M. M., Pennsylvania Lines, Wellsville, Ohio, reported on Train Lighting, and presented in detail the voltages that should be used for straight storage, head-end and axle-dynamo systems, and that where lead storage batteries are used they shall be preferably installed in double compartment tanks. Numerous illustrations were given of the details of lighting apparatus. The committee recommended the adoption of standard size straight axles for different journal sizes for use with axle dynamos. With the present standard tapered axle it is very difficult to properly secure the axle pulley or bushing. The straight axle would result in less maintenance cost in axle pulleys and belts, and improvement in service. A number of roads have already adopted the straight axle, and if this practice spreads, the diameter of the axle should be standardized. The adoption of a standard system of axle-dynamo suspension was also recommended.

Provision of Standards and Recommended Practice.

Mr. T. H. Goodnow, Armour Car Lines, Chicago, Ill., presented the report on the above subject, and showed that inquiries had been made and many replies received presenting suggestions, many of which were approved by the committee. These embraced some of the lesser details of car, truck and brake construction. These aimed largely towwards a more complete standardization of parts. A valuable recommendation was received by the committee from McCord & Co., the well-known railway supply firm, in regard to some inconsistencies in freight and passenger journal boxes, as far as the dust guards and dustguard slots are concerned. This was referred to the Committee on Car Trucks. The location of lamp sockets was recommended to be located at an agle of 45 degs. on the corner part of the car and approximately 9 ft. 6 ins. from the rail to the bottom of the slot of socket.

M. M. Reports

Safety Valves.

The Committee on Safety Valves, of which Mr. W. J. Tollerton, assistant general superintendent of motive power, Chicago, Rock Island & Pacific Railway, was chairman, presented a formula for the diameter of safety valves as follows:

ASSUMING VALVES HAVE 45-DEGREE SEAT.

D — The total of the actual diameters of the inner edge of the seats of valves required.

H — Total heating surface of boiler in sq. ft. (Superheating surface not to be included.)

L — Vertical lift of valve in inches.

P — Absolute boiler pressure in lbs. per sq. in.

$$D = .036 \times \frac{H}{L \times P}$$

EXAMPLE.

$$\frac{.036 \times 2878}{.1 \times 200} = 5.2'' \text{ Diameter}$$

which would require two 3-in. valves.

The committee further reported that the only accurate method of determining the capacity of safety valves is by actual test in a testing plant, with safety valves fully equipped with springs, as in actual road service. In order that it should be positively known that safety valves will prevent undue raise in pressure under

extreme conditions, they should be subjected to a road test.

Nickel valves and valve seats were referred to as desirable, but are expensive as to first cost and renewals, and the committee recommended the continuance of the use of bronze alloys.

The practice of screwing down the safety valves during a hydrostatic test was condemned. One safety valve should be removed and replaced with a special valve, and the other valve or valves should be removed and replaced with caps or plugs during test.

Flange Lubrication.

The Committee on Flange Lubrication had been continued to make further report and had been increased from three to five members, Mr. M. H. Haig, M. E., Atchison, Topeka and Santa Fe Railway, Topeka, Kan., acting as chairman.

In the course of the report it appeared that some of the railways which have already made service trials have satisfied themselves as to the effectiveness of flange lubrication. They do not feel justified in going to the expense of still further tests to provide data for additional information. Having determined that lubrication is reducing flange wear and proving economical, they are proceeding with the application of flange lubricators and consider the experimental stage to have been passed. Since closing the 1911 report advice has been received of flange lubricators having been applied by over thirty railroads on which lubricators had not been used previously. In most cases reported, the number of locomotives equipped on each road has been small. In one instance, however, a road operating over 1,100 locomotives has applied flange lubricators to the entire number.

Among these railroads on which lubricators have been used, no cases have been reported where flange lubrication has been abandoned. A number of roads have removed certain types of lubricators applied experimentally and replaced them by others. The types of lubricators applied during the past year indicate the most general adoption of crude oil as a lubricant. Some reports state that hard grease has been rejected as unsatisfactory due to the fact that the grease catches and holds sand. The abrasive action resulting has increased instead of decreased the flange wear. Graphite as a flange lubricant has been reported as successful by some roads, but others have abandoned it for crude oil. Crude oil with a heavy asphaltum base is spoken of with the greatest favor by roads using flange lubricators. It has been successfully applied by both hydrostatic and gravity-feed devices.

The Collins flange lubricator illustrated and described in the former report has since been improved. The improved device is similar in construction to that already described. The feeding device of the original type was placed under the body of the lubricator. The lubricating block of graphite composition was pressed against the flange by a pawl engaging in notches in the under side of the block. With the improved type a coil spring and plunger acting directly behind the block of lubricant presses it against the flange, the feed being continuous without adjustment until refilling is necessary. The 1911 report has given the impression that this lubricator was designed to use hard grease. It should be stated that the lubricant is graphite.

The Hocking Valley Railway Company reports that the service of switch engines operating upon industrial tracks with much sharp curvature has been increased from four months to twelve months. On consolidation engines subject to excessive wear of front and back flanges the service of tires has been increased from one year to two years. At the end of this period the flanges are still in good condition.

The flange lubricator, like other devices, requires attention. Any defects or any imperfections in the device or its connections should be included by the engineer in his work report at the end of his trip. This work should be done by the roundhouse force, and the roundhouse should be held responsible for repairs.

Maintenance of Superheater Locomotives.

Mr. R. D. Smith, superintendent of motive power, Boston & Albany Railroad, Boston, Mass., chairman of the committee on the above subject, presented a very comprehensive report showing that reports had been received representing 70 per cent. of the total number of locomotives in the United States and Canada using superheated steam.

Twelve roads reported that cylinder and steam-chest bushings on superheater locomotives wear out more rapidly than on locomotives of the same classes using saturated steam, and twenty roads replied that there is no perceptible difference in the wear of cylinder and steam-chest bushings between locomotives using superheated steam, as now operated, and those using saturated steam. All roads reporting more rapid wear on superheated steam than on saturated steam locomotives have superheaters of the fire-tube type, giving a high degree of superheat, but all roads having superheaters of this type do not report more rapid wear of bushings. Several roads favored the use of piston and valve rod extensions and also the use of larger and heavier pistons. Twenty-three roads reported that there is no unusual difficulty on properly lubricating the cylinders and steam chests, and five roads reported that it is difficult to properly lubricate superheated locomotives. The majority of reports indicate that it is more difficult to lubricate locomotives with smoke-box superheaters than to lubricate the ordinary saturated steam locomotive. Hydrostatic lubricators are generally approved of.

Sixteen roads report they have found Hunt-Spiller gun iron the best metal for cylinder and steam-chest bushings, and one other road intends to use this iron for cylinder and steam-chest bushings of new locomotives. Nine roads state they are using gray iron for bushings, three roads use the same metal for the bushings of superheater locomotives as it used for saturated-steam locomotives, and one road is undecided as to the best metal.

All the roads favoring the use of Hunt-Spiller gun iron for bushings also favor its use for piston and valve packing rings, and two other roads report using this material for rings but do not use it for bushings.

The allowance of valve oil per 100 miles for superheater locomotives varies according to type and service. The maximum allowance reported for Pacific type locomotives with fire-tube superheaters is 3.25 pints per 100 miles and the minimum 1.25 pints, the average allowance being 2.25 pints. For Consolidation locomotives with fire-tube superheaters, the allowance of oil varies from 2.50 pints to 1.25 pints, the average being 1.75 pints per 100 miles. The average allowance of oil for Mikado locomotives with fire-tube superheaters is 4 pints, and the allowance for Mallets is about 6 pints per 100 miles.

Replies to the Circular of Inquiry indicate that Hunt-Spiller gun iron has been used on many railroads with excellent results. This is stated to be an air-furnaced charcoal iron, and the process of manufacture, combined with proper chemical composition, seems to result in a metal which is well adapted for use with highly superheated steam. The analysis of this iron, obtained by the committee, is as follows:

Silicon	1.40 per cent.
Phosphorus	0.35 per cent.
Sulphur	0.07 per cent.
Manganese	0.49 per cent.
Combined carbon	0.80 per cent.
Graphite carbon	2.20 per cent.

Replies indicate that this same iron has been used extensively for piston and valve packing rings on superheater locomotives with very satisfactory results, and that an iron of this character is the best metal so far produced for piston and valve packing rings of superheater locomotives.

When superheater locomotives were first placed in operation it was to be ex-

pected that certain difficulties would be experienced, but these difficulties have been overcome one by one, and, with reasonable care in operation and with proper attention on the part of enginehouse forces, superheater locomotives will be no more difficult to maintain than saturated-steam locomotives of the same classes.

Steel Tires.

Mr. Lacey R. Johnson, assistant superintendent of motive power, Canadian Pacific Railway, Montreal, Canada, chairman of the Committee on Steel Tires, reported that since the last convention the committee, which was continued with a view to presenting a specification from which railway companies could purchase tires, with confidence that they would give the service expected, have worked to that end, and although it would be impossible to construct a specification every clause of which would meet with every member's ideas, and also fill in detail all the ideas of every member, they felt they had a good working specification, which, if followed by the manufacturers, will produce tires which will give satisfactory service on any road on this continent.

The chemical composition should be as follows:

Carbon, not less than...50% or over 70%
Phosphorus, not over...05%
Manganese, between....50% and 80%
Sulphur, not over.......05%
Carbon, not less than...60% or over 80%

Drillings from a small test ingot cast with the heat, or turnings, from a tensile specimen, or turnings from a tire (where tires are machined at the works of the manufacturer) shall be used to determine whether the chemical composition of the heat is within the limits specified. When required, the purchaser or his representative shall be furnished an analysis of each heat from which tires are made.

Tensile test specimens, one from each heat, must be forwarded to the engineer of tests of the railway company, together with a copy of the chemical analysis of each heat, showing the tire numbers rolled from each heat; also destination of each tire, together with the railway company's purchasing agent's order number. If, however, the manufacturer is rolling tires right along for the railroad company, and their inspector is at their plant, the test specimens from heats ready at that time may be pulled at the manufacturer's plant by the inspector and the broken test pieces sent in for analysis, in which case the above information must be furnished the inspector.

A specimen for the tensile test is to be taken from a tire that has been subjected to a falling weight test, and it shall be cut cold from the tested tire at the point least affected by the falling weight test. The tensile test specimen when cut from a tire that has been subjected to a falling weight test shall be cut normal to the radius and parallel to the face.

Mechanical Stoker.

The report on Mechanical Stokers, presented by Mr. T. Rumney to the Railway Master Mechanics' convention, is evidently a faithful record of the progress made during the last year in this line of railway progress; but it has been by no means so rapid as might have been expected. The committee had prevailed upon several railway companies to apply two mechanical stokers to some of their large locomotives, and the result has been that these—the Crawford Underfeed Stoker and the Street Overfeed Stoker—are the only two prominently at work performing satisfactory service.

Certain improvements have been effected on these stokers during the year which resulted in making their operation practical, with the introduction of improvement of details such as would result from the experience gained in showing up weaknesses of parts.

Since the advent of the mechanical stoker, railroad officials have introduced fuel-saving appliances that have greatly reduced the work of the fireman and have to some extent obviated the necessity for the mechanical stoker. The superheater has greatly reduced the fuel consumption for a required volume of steam, while the general introduction of the brick arch has produced similar desirable effects. Improved boilers and attention to proper firing have also helped to lessen the quantity of fuel required to maintain steam so that the demand for mechanical stokers is by no means so urgent as it was when that invention was first introduced. It does not follow, however, that mechanical stokers will fall out of service. The increasing size of locomotives, which seems to have no limit, will soon renew the demand for appliances to carry the heavy work so long done by overworked firemen.

The committee's report mentions seven other mechanical stokers besides those referred to, but they have gone little beyond the experimental stage, although some of them seem capable of useful development.

Low Water Detector and Controller.

Ever since steam boilers were introduced, there have been boiler explosions, many of them caused by heated sheets, due to low water. A great many inventions have been devised with the view of detecting shortness of water in boilers, but none of them proved reliable until the Neville Safety Apparatus for Steam Boilers was developed.

Mr. D. P. Kellogg, of the Southern Pacific, speaking at the Master Mechanics' Convention about the invention referred to, said: "To prevent accidents due to low water in the boiler, we have endeavored to perfect an apparatus which has proven satisfactory so far. It is operated by a difference of temperature, which is secured by entrapped water in a cup and partially cooled to about 50 degrees Fahr. lower in temperature than the water in the boiler. When the water in the boiler falls to any prescribed limit, the man in charge of the locomotives sees the danger line, or steam enters and expands a body of mercury in the device, which opens a steam valve and sounds an audible alarm (blow a whistle) or control the fire. In the case of an oil burning locomotive, it shuts off the fuel supply, and in the case of a coal burning locomotive it sprays the fire with a jet of water. There are about 40 of these devices in use on the Southern Pacific at the present time; they have proved quite satisfactory and it is the expectation that we will extend the application of them to a great extent."

We have carefully examined this invention and find its construction to be simple and its action certain. In our opinion it is one of the most important inventions ever offered to boiler users. We expect to illustrate this valuable safety device in our next issue.

Things That Kept Him Down.

The greater part of the men who rise to hold sway as railway officials, begin work as clerks of some kind. Many begin as clerks and end there—some of them through sheer bad luck, others because they did not possess the attributes that force success.

An explanation why several unfortunates failed to rise is thus given:

He watched the clock.

He was always grumbling.

He was always behindhand.

He had no iron in his blood.

He was willing, but unfitted.

He didn't believe in himself.

He asked too many questions.

His stock excuse was, "I forgot."

He wasn't ready for the next step.

He did not put his heart in his work.

He learned nothing from his blunders.

He felt that he was above his position.

He chose his friends from among his inferiors.

He ruined his ability by half-doing things.

He had vague dreams that something good would come to him without effort.

He did not develop the best that was in himself so he fell behind in the race that we all have to run.

General Foremen's Department

Annual Convention of Railway General Foremen's Association.

The Eighth Annual Convention of the International Railway General Foremen's Association will be held in the Hotel Sherman, Chicago, July 23-26 next. We understand that Secretary Bryant has been actively pushing the chairmen of committees to prepare their reports and that most of them will be in print before the convention meets. President Pickard has taken much interest in this part of the work and his influence is of the most satisfactory character.

The questions to be reported upon and discussed relate mostly to matters concerning shop foremen's duties. They are:

First, "How can a shop foreman best promote efficiency?" of which President Pickard is chairman.

Second, "Why is it necessary to have wheel pit, engine truck and driving wheels larger than diameter of journal?" Stephen A. Motta, chairman.

Third, "Shop Kinks," by H. D. Kelley.

Fourth, "Shop Organization," by D. E. Barton.

The convention will not be overburdened with subjects, but those to be discussed are sufficiently important to occupy the whole of the time available. The subject, "How can a shop foreman best promote efficiency?" is calculated to bring out useful information that will improve the practice in all the shops supervised by members of the association.

Rochester Boring Machine.

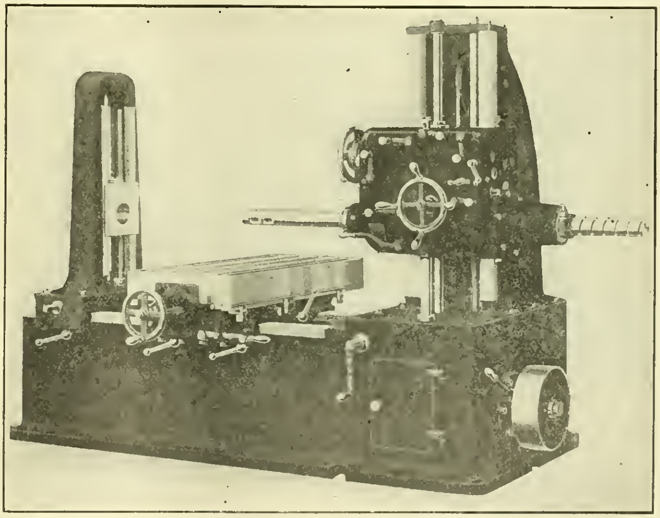
A new machine of unusual interest and embodying many original and novel features is illustrated and described herein as the Rochester "Table Type" Boring, Milling, Drilling and Tapping Machine. By its means the operations also of splining, oil grooving and thread cutting can be readily accomplished.

The most striking features of the machine are the centralized control and the simplicity of the design. Every change of feed, speed or traverse in every direction, as well as the starting, stopping and reversing, all being instantly obtained from one position convenient for the operator to his work, and all being so arranged that no two conflicting levers can be engaged together at the same time.

The machine is designed and built so that the various machining operations can all be performed at the same setting of the work, it being much easier and quicker to change the cutters or the tools in the machine than to transfer the work to several machines for each different operation.

All feeds before applied to the different parts are transmitted through a friction clutch so as to make possible the instantaneous engaging or disengaging of the same.

Sixteen boring and drilling feeds are provided, also sixteen different milling feed for the saddle and the table. An oil pump lifts the lubricant to reservoir at the top of saddle, and from there it is distributed by leaders to the different bearings, the overflow running over the gears, providing an ideal oiling system, actuated automatically.



ROCHESTER BORING, MILLING, DRILLING AND TAPPING MACHINE.

The details above described are but a few of many improvements and original features of these machines, all of which help to insure maximum efficiency in production and convenience in operation.

They are built for the Rochester Boring Machine Company, of Rochester, N. Y., in two sizes at the present time—one with 3-in. spindle and the other with 3½-in. spindle. The construction of the machine is such that the standard range can be very readily varied to suit special requirements when needed, while in point of substantial construction it is not surpassed by any machine now on the market.

Improved Method of Case Hardening.

The ordinary method of case hardening has been done by heating the articles packed along with charcoal in an iron box, for several days in a horizontal muffle before withdrawing and quenching them in water. Besides being very slow, this process frequently led to serious distortion of the hardened steel, which had to be ground to the required shape, and, further, there was an excessive concentration of carbon in the superficial layers of the metal and a rapid diminution of the carbon in the deeper zones, which often caused brittleness and peeling of the skin.

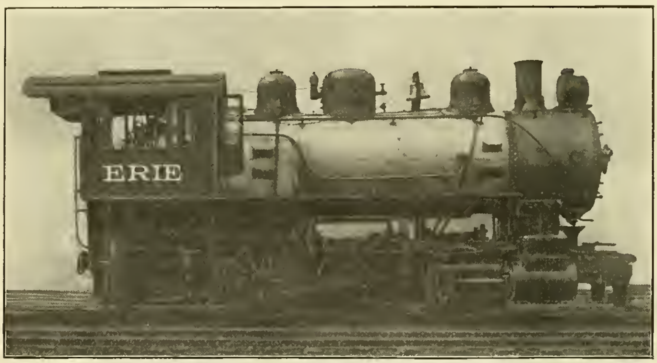
Recent methods, using solid cementing agents which contain a high proportion of cyanogen compounds, are very much quicker, often requiring less than an hour to produce moderate depths of case-hardening, but their action has been proved to be too energetic, thus producing the same defects as before, due to the sudden lowering of the carbon content in the deeper layers. Gaseous and volatile hydrocarbons when used alone as case-hardening agents led to trouble from identical causes.

Considerable attention has been devoted within the last few years to the researches and discoveries of Dr. F. Giollitti, of Genoa, who has invented a new industrial process for the case-hardening not only of ordinary mild steel but also of most of the special alloy steels which have proved

hitherto so difficult to "case" successfully. This investigator has proved it possible, by the specific carburizing action of carbon monoxide gas at temperatures varying from 900 to 1,100 degrees centigrade to obtain a definite concentration of carbon uniformly over the whole surface of the article treated, and a gradual diminution of the hardness of the casing inside the carburized zone. Such definite results are got by varying, in accordance with rules established by Dr. Giolitti. (a) The temperature at which the case-hardening is performed; (b) the pressure of the carburizing gas; and (c) the amount of carbon monoxide which in a given time comes in contact with the surface of the steel to be carburized.

Lohmannized Steel Locomotive Jacket.

Maintaining locomotive jackets in good order to present a decent appearance has always been a troublesome problem for locomotive men. In foreign countries the locomotives are covered with sheet iron that is made to look respectable by frequent paintings; but on the American Continent Russia iron has been almost universally used and the gases that emanate from the boiler and firebox make that kind of covering short lived. We anticipate a prompt remedy for this trouble in the covering of locomotive boilers with Lohmannized steel. The locomotive here shown is covered with that material, which has been done as an experiment, an experiment which has been so satisfactory as to seemingly sound the knell to all other forms of boiler covering. Metal subjected to the Lohmannizing process is rendered impervious to corrosion from any known cause, which makes it particularly suitable for boiler covering. The bright appearance of the Lohmannized boiler covering is in its favor and is likely to make it popular with the men in charge of locomotives.



LOCOMOTIVE WITH LOHMANNIZED STEEL JACKET. NO. 101. ERIE RAILROAD.

Engineering Drawing.

In more than one respect the engineering draughtsman has a more difficult, though more useful, task than that of the pictorial artist. There are no lines in nature, and the landscape or figure painter aims to impart to the observer the mental impression produced by the object on his own mind. Working in line, he can only suggest that impression and his meaning; but the observer's imagination supplies any lack of interpretation.

The engineering draughtsman must leave nothing to the imagination. He has to convey exact and positive information regarding every detail of the machine or structure he depicts. His drawing, therefore, is a complete graphical language; but, inasmuch as it does not show the object as it would appear when constructed and as the eye would then behold it, his drawing can only be understood by one trained in the language. It is, therefore, a first necessity that all engineers should thoroughly grasp the two modes of expression—mechanical drawing and technical sketching.

Utilizing Old Bolts and Nuts.

At a meeting of the mechanical officials of the Erie Railroad, the subject of straightening, rethreading and cutting of old bolts, also retapping and properly caring for old nuts was very thoroughly discussed, and it was decided that immediate attention should be given this work at both the locomotive and car shops, and that some old man at each one of these respective places who is not able to do hard work should be selected to carry out this practice. If, after careful investigation, it is found that at the locomotive shops there is not enough of this work to require the entire time of one man to look after same, this class of material will be collected together and turned over to the car department, where it will be properly sorted and cared for.

Recasting Alloys.

Investigations have been made at the German official testing bureau for materials to ascertain to what extent repeated melting of bearing metals influence their strength and reliability. As regards white metal (alloys of copper, antimony and tin), it was found that repeated meltings did not noticeably alter the grain, but that the rate of cooling had a considerable influence. Quick cooling yielded a finer grain and higher hardness and strength, and the investigators recommend that white metals should not be heated to high temperatures, and that they should be cooled rapidly. Bronze, poor in tin, and, therefore, comparatively inexpensive, may have the hardness and strength increased by being rapidly cooled from a temperature of 1,440 deg. F.

Removing a Nut.

Repeated applications of kerosene or gasolene will almost always aid in the loosing of a refractory nut. A final effort may be made by lighting a little cotton waste soaked in kerosene around the nut and applying the spanner before the bolt or stud has had time to become heated. Tapping the faces of the nut with a hammer will also frequently induce a loosening of the nut. As a last resort splitting the nut with a chisel is cheaper than breaking the bolt.

Filler for Defective Castings.

One and a half part litharge, two and a half parts dextrine, four parts iron borings or turnings carefully sifted. Mix the parts well, add water until the mass is of about the consistency of mortar. With a putty knife or other instrument fill the defective parts and press into every crevice. Let it set for 48 hours, when it can be chipped, planed, bored, or turned like the casting itself. Color with lamp-black to suit shade of casting.

Sticking Gaskets.

Where asbestos and some other materials are utilized for gaskets they are apt to stick to the metal and upon overhauling must be scraped off. This means making new members and a loss of time and a source of expense to the owner. A tight fit may be made by rubbing the packing and metal parts with dry graphite. This is not affected by heat and will allow the gaskets to be removed as a whole.

Degrees of Curves.

If the angle of deflection is one degree, the radius of the curve will be 5.730 ft.; 2 degs. is the half of that amount, and so on. A 10-deg. curve has 573 ft. radius.

Questions Answered

EXHAUST NOZZLES.

180. A. F. K., Peru, Ind., asks: Will a jet of steam escaping from a nozzle tip and going directly up the stack with nothing to excite the spreading of the exhaust more than its natural expansion produce as much vacuum in the front end as steam escaping with a bridge or split under same conditions? In other words, does the exhaust sriking the sides of the stack have the effect of filling the stack and produce more vacuum than the exhaust going straight up the center of the stack with increased velocity? A.—It is very essential that the exhaust steam should completely fill the smoke stack, otherwise a perfect vacuum could not be secured, and the effect upon the fire and upon the steaming qualities of the locomotive would be of the most pernicious kind. The subject is very fully treated in the twentieth chapter of Angus Sinclair's "Locomotive Engine Running and Management."

GLASS WATER GAUGE.

181. N. G., Saginaw, Mich., asks: What are the indications of a defect in the water glass of a locomotive? A.—The only indications apart from the breakage of a glass water gauge is the water becoming stationary in the glass. It will be noted that when the locomotive is in motion, the water is constantly moving upwards and downwards in the glass. If the water remains still in the glass it is a sign that the opening in the bottom of the glass has become clogged.

DEPRECIATION OF MACHINERY.

182. W. S. G., Pittsfield, Mass., writes: Is there any exact rule that can be followed in regard to the depreciation of machine tools in constant use, and how much should be deducted in estimating their value in comparison with the prime cost? A.—There is no exact rule in regard to the depreciation of machinery as it depends on the kinds of work performed and its effect on the machine which the practised eye can readily detect. In regard to lathes and machine tools generally, it is common practice to estimate a loss in value of 5 per cent. annually. In the case of engines, shafting, gearing and the like an average loss of 7½ per cent. annually is considered a fair estimate.

STUFFING BOX SPRINGS.

183. P. McB., Belfast, Ireland, writes: (1) In fitting a stuffing box with metallic packing, I found that it took 120 pounds to close spring 3/16 of an inch. Does it follow proportionally that if the distance between gland face and stuffing box is one inch, when rings are in place, that the total pressure on the rings will be in direct proportion to this amount? A.—All spiral springs increase in pressure in an exact ratio to the distance compressed. In the case referred to the pressure would be excessive, and it may be added that in general practice there is no fixed rule in regard to the exact amount of pressure that should be placed on stuffing box springs, the point where leaking ceases being readily determined by experiment, and any pressure beyond this not only retards but injures the piston. (2) What is the co-efficient of friction for white metal on lubricated surfaces? A.—.125.

FLOW OF STEAM THROUGH AIR PUMP.

184. C. R., Niagara Falls, Ont., writes: Would you kindly trace the flow of steam through the Westinghouse air pump? A.—Assuming that you mean the simple or direct acting 8-in., 9½-in. or 11-in. pump, steam from the boiler enters the top head through a port in the steam cylinder where it is effective on the inside surfaces of the differential piston and on the upper surface of the main slide valve; from there it flows through a suitable port to the reversing valve chamber holding the reversing valve to its seat in the bushing. The action of the differential piston or main valve then depends upon the position of the reversing valve, which is controlled by the position of the main steam piston; but assuming that the main piston is at the bottom end of its stroke, as it should be when there is no steam pressure in the cylinder, the live steam entering between the differential piston will move the pistons and attached slide valve in the direction of the piston presenting the largest area for steam pressure to become effective upon, and as it moves the slide valve it uncovers the port leading to the under side of the main steam piston, forcing it to the top end of the stroke, while the slide valve cavity opens the upper end of the steam cylinder to the exhaust port and exhaust pipe. When the steam piston now nears the upper end of its stroke, the reversing plate strikes the shoulder of the valve rod to which the reversing valve is attached, and moves the reversing valve to a position to admit steam from the reversing valve chamber to the chamber on the outside of the large piston of the main valve, which balances the pressure surrounding the large piston, allowing the steam pressure in effect on the smaller piston to move the pistons and slide valve to the opposite end of its stroke, which opens the lower end of the steam cylinder to the exhaust passage and at the same time admits live steam to the upper end of the steam cylinder, forcing the main steam piston to the lower end of its stroke, and when it nears the end of the stroke the reversing plate engages the button on the end of the valve rod, drawing the valve and rod down to the original position we have assumed, the reversing valve exhausting the pressure from the outside of the large main valve piston whereupon the operation just mentioned is repeated.

DUTIES OF AIR PUMP PARTS.

185. C. R., Niagara Falls, Ont., writes: What is the duty of the reversing valve in the air pump? A.—The duty of the reversing valve is to admit steam to, and exhaust steam from, the outside surface of the large main valve piston which controls the movement of the main valve. To state the duties of the other four movable parts of the steam end of the pump may make this more comprehensive. The duty of the main valve piston is to give movement to the main slide valve. The duty of the main slide valve is to admit steam to, and exhaust it from, both ends of the steam cylinder which imparts the movement to the main steam piston. The duty of the main steam piston is to move the air piston for compressing the air and to actuate the reversing valve rod. The duty of the valve rod is to impart movement to the reversing valve, the duty of this valve being the subject of inquiry.

LOCOMOTIVE AIR SUPPLY.

186. J. B. I., Lakeland, Mich., writes: Why are some new steel passenger cars two 11-in. air pumps instead of one 8½ or 10½ cross compound pump? A.—Because some motive power officials prefer two separate pumps so that in the event of a failure of one pump, the other could be relied upon to prevent an engine failure, while at the same time it is understood beyond question that the cross compound method is by far the most economical for train brake air supply.

IMPERATIVE DRIVER BRAKE.

187. J. B. I., Lakeland, Mich., writes: Does the law requiring engines to be equipped with driver brakes say that they are to be maintained in an effective condition at all times? A.—Our understanding of the law is that an inoperative driver brake, either in road or yard service, is a penalty defect.

NAMES OF TRIPLE VALVES.

188. J. B. I., Lakeland, Mich., writes: What are the names of the new freight car triple valves put out by the New York Air Brake Company? A.—K5 and K6.

Railway Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances.

Published Monthly by

ANGUS SINCLAIR CO.

114 Liberty Street, New York.

Telephone, 746 Rector.

Cable Address, "Locong," N. Y.
Glasgow, "Locoauto."

Business Department:

ANGUS SINCLAIR, D. E., Prest. and Treas.
JAMES KENNEDY, Vice-Prest.
HARRY A. KENNEY, Secy. and Gen. Mgr.

Editorial Department:

ANGUS SINCLAIR, D. E., Editor.
JAMES KENNEDY, Managing Editor.
ALLEN G. WOOD, Consulting Engineer.
GEO. W. KIEHM, Associate Editor.
A. J. MANSON, Associate Editor.

Boston Representative:

S. I. CARPENTER, 643 Old South Building, Boston, Mass.

London Representative:

THE LOCOMOTIVE PUBLISHING CO., Ltd., 3 Amen Corner, Paternoster Row, London, E.C.

Glasgow Representative:

A. F. SINCLAIR, 15 Manor Road, Bellahouston, Glasgow.

SUBSCRIPTION PRICE

$2.00 *per year,* $1.00 *for six months, postage paid in the United States, Canada and Mexico. For other parts of the world,* $2.50, *or ten shillings. Single copies, 20 cents. Remit by Express Money Order, Draft, Post Office Order or Registered Letter.*

Mailing address can be changed as often as necessary—always give old and new address, and if you subscribe in a club, state the name of the agent.

Please give prompt notice when your paper fails to reach you regularly.

Entered at the Post Office, New York, as Second-class Mail Matter.

The Efficient Traveling Engineer.

It used to be the regular practice when railway companies were moved to cut expenses that the services of traveling engineers were dispensed with as being a saving that entailed no loss. When the traveling engineers were selected through seniority, the oldest working engineer being considered entitled to promotion to be traveling engineer, the services of these officials helped very little to promote habits of economy among the enginemen, but of late years an entirely new policy has been adopted and master mechanics and superintendents of motive power have fallen into the habit of selecting traveling engineers who are real help.

A master mechanic cannot ride on engines night and day to watch the working of every kind of device used. If he tries a patent piston packing, he puts it on one or more engines run by engineers on whose common sense and judgment he can rely, and lets their verdict settle its merits and demerits. If master mechanics do not see through the eyes of their men, why do they appoint representative engineers as road foremen of engines, or traveling engineers to look after trials of new things, watch and instruct new men, order repairs on engines that they, themselves, have not seen, condemn engines and give them advice about everything on the road? A traveling engineer is the confidential clerk of the master mechanic, and the official sees through his eyes. Some of the greatest and most successful superintendents of machinery have a general traveling engineer, and one for each division to see, think and judge for them and yet unthinking men say enginemen have no influence.

Unwilling Heroes.

It has become the style, now, for the press and public to laud the deeds of dead engineers and call them heroes and martyrs, etc., and while they live treat them with silent contempt and as nothing but greasy, ignorant laborers. Naturally engineers cling to life as much as anybody and few of them care to die just to be called a hero and have his grave covered with flowers. He would rather be treated as a man and an intelligent mechanic and receive a few flowers now.

Engineers are never dead heroes from choice; they are sacrifices on the altar of duty. It is just as natural for an engineer to do all in his power to stop in an emergency as it would be for a woman to scream under the same circumstances. It is their training. Like veterans in battle, who obey any order unflinchingly because they are used to obeying. Any engineer who has done all in his power to stop, for instance, in a collision, is very foolish to "die at his post" if he can get off. Engineers' lives are too valuable to throw away in this manner. Men become so used to emergencies that require prompt and quick action, that of applying brakes, reversing engine and opening sand lever is but the work of a few seconds, and is, in ninety-nine cases in a hundred, done before the engineer thinks that the first law in nature is self-preservation.

It is the years of experience that engineers get in front of danger that makes them the factor of safety to the train that they now are. It is this training that makes them skilled mechanics of a high order. It is this training that makes it impossible to supplant the engineers of this country by any other class of men in any emergency. The engineers of this country may be depended upon to do their duty regardless of circumstances, and will be dead heroes only because there is no time to escape after that duty is performed.

A soldier who has fired his last shot would be foolish to throw down his musket and rush to death upon the bayonets of the enemy. So is an engineer, who has done all he can, foolish to refuse safety if safety can be found.

Leaks in Piston Packing.

It would be difficult indeed to estimate the loss occasioned by leaks in piston packing, but any one at all familiar with locomotives knows that it is enormous. It is no fault of the packing, as almost all packing either on piston or valve rods has the quality of adjusting itself to the rod and maintaining a steam-tight joint at all times. As is well know the packing consists of a gland, ball-joint, vibrating cup, three soft metal rings known as one ring, follower, preventer, spring, swab cup and oil cup. The gland is for the purpose of holding the packing in the stuffing box, and furnishing a bearing or seat for the ball ring which forms a universal joint between the vibrating cup and the gland. Hence the packing is, properly speaking, a floating packing and follows the rod whether the rod be exactly central or not. The vibrating cup holds the packing rings in their proper position. The ring is of soft metal, and is the only wearing part of the packing, as no other part of the device should come in contact with the moving rod. The flange follower is used to transmit the spring pressure to the packing ring or rings, and to follow up the packing as the inevitable wear takes place. The chief purpose of the spring is to keep packing rings and all joints in proper position when steam is shut off, and is not as is supposed by many for the sole purpose of setting in the packing as the wear takes place. The steam presses the rings on the piston.

At the same time the spring should be strong enough to hold the packing firmly together, as without the spring there would be nothing to prevent the packing from becoming disarranged when steam is shut off. The preventer is for the purpose of only allowing the packing to move backward and forward about 1-16 of an inch, thereby insuring its perfect flexibility. When the packing becomes dry or rod becomes rough, if it were not for this preventer the packing would hang to the rod on its inward stroke, compressing the spring until the coils become tightened, and when engine took steam, the packing would be forced up against the gland with such force as to crush the packing or perhaps break the gland. The preventer also furnishes a close fitting casing around the outside of the spring, and never allows the spring to come in contact with the rod by allowing the spring to become cocked. The swab cup per-

forms an important function in furnishing a reliable lubrication to the packing, as the oil cups do not always accomplish the purpose intended, as cups are frequently filled with cinders, and pipes become choked or broken off. Both should receive careful attention.

Leaks occur when too much is cut out of them. When in proper working order they should come solidly together. They will last much longer in this way than when separated at the points. They should never be cut after the first time and then 1-16 of an inch is enough. Leaks also occur if the piston is much worn. Tapering and shouldering of the piston is inevitable and a departure of 1-32 of an inch at any part of the piston from the exact truth will cause a leak. It should always be remembered that neither the piston or the packing will last forever. Much time and waste of steam will be saved by trueing up the rods and renewing the packing. This precaution with good lubrication will insure tight packing.

The rings should be machined all over. The three rings should be faced separately, and the outside ring should conform to the vibrating cup. They should be sawn apart with a 1-16 inch saw. On no occasion should one new ring be placed with other older and worn rings. They will never fit properly. They should fit exactly on the rod. Leaks also occur by reason of foreign matter getting in the joints, and frequent cleaning is necessary, and possibly a refitting of the joints. The nearer the centre the rods are the better will the result be. This is especially true of the valve rod, which rapidly falls below the centre, and should be kept in place. The joints in the rings should be separated when placed in the vibrating cup, and a leak should never be allowed to continue until a more convenient season. The loss is exactly the same as if two streams of coal and water were running continuously out of the coal box and tank with this difference: that the loss is lost forever.

The Note of the Exhaust.

When locomotives fall into bad order owing to the natural wear of service, the dictates of economy requires that they should be put into the shops for repairs as soon as possible; but numerous roads are behind in the repairs of their motive power so that needed repairs are delayed, while other companies follow the policy of keeping the engines at work as long as they will run without delaying traffic. The consequence of this is, that many locomotives in very bad order are kept pulling trains and causing delays that would not happen under a sounder business policy. Every person who has had anything to do with handling engines in this condition is aware that the motive power is operated at great expense for fuel and lubricants to say nothing of the excessive wear of parts incident to the motion being in bad order, which also causes defective distribution of the steam. The writer spends many nights close to a railroad point where the road engines have to do considerable switching and it is painful to listen to the exhaust of some of them which loudly proclaim, "Valves needing adjustment."

Many of these locomotives could be greatly improved by a little work devoted to adjusting the valves which could be done in a few hours. There is every reason to believe that many of the half worn engines limping over the country and kept out of the back shop by the poverty of their owners, could be greatly improved were easy means adopted to arrange the distribution of steam properly or as near as the deteriorated condition of the motor would admit.

So long as the sound of the exhaust gives no indication that the valves are out of square, many master mechanics and road foremen of engines accept that as conclusive evidence that the valve motion is all right, although as a matter of fact the exhaust sound is a most deceptive means of judging the condition of steam distribution. All that a square exhaust demonstrates is, that a fairly uniform volume of steam enters the cylinders and passes out at nearly uniform periods. It gives no clue to conditions that indicate waste or economy of steam. The locomotive may be working under all the disadvantages of restricted or post admission, wasteful back pressure and excessive compression, yet the exhaust may tell those who believe in its note, that the engine is working admirably, without a fault. There are too many who believe implicitly in that note and are grievously deceived.

On a road known to the writer, a locomotive that was getting well worn, began to stall on hills with trains that had formerly been pulled over with ease. The valves sounded square and nothing could be found to indicate the impaired efficiency; but the master mechanic in charge being a progressive man applied an indicator and found that the valves were badly cut and the compression was excessive. The valves were faced and adjusted, then the engine resumed the practice of doing the work of train hauling with its former efficiency, and with decided saving of fuel. The improvement affected on that single engine paid the cost of the indicator. If the steam engine indicator were called more into requisition to find out the maladies of locomotives and to show how the steam was used it would be the best paying instrument about locomotive headquarters.

Jumping Backward Off Moving Car.

Riding trains is such a universal practice among grown people that it might be supposed that every person of ordinary intelligence would know that it is not safe to jump off a car backward; but many people, who have not escaped from institutions for the feeble minded, jump off moving trains with their back to the engine or to the motorman. In getting off a car the safest way is to wait until the car stops, but the multitude who are set upon saving a second of time by jumping off the car before it stops, ought to reflect that their bodies will keep moving in the direction the car is going, and that it is difficult to keep up that motion if they have to run backward.

Women are particularly prone to. step off moving cars backward, and claims have repeatedly been brought against railroad companies for damages to compensate for injuries sustained by women trying to overcome the laws of moving bodies. A representative case of this character was dealt with by the Supreme Court of Ohio last month. A silly woman, hailing from Youngstown, jumped off a car backwards with the effect that her dignity and her person suffered. She immediately claimed damages through the district court and a jury, which practically decided "served you right"; then she appealed to the Court of Last Resort, which rendered a decision that every woman's publication ought to keep in standing type. It reads:

"When a woman steps backward from a moving street car and is injured, she is entitled to no damages."

Prospects of Limited Parcels Post

There is no question before the public today which concerns the people at large so intimately as the establishing of a parcels post, but Congress shows decided reluctance to free the public from the tyranny of the worst and most exacting monopoly that ever tyrannized over the American people. There are very few people who do not receive or send packages. Every person who receives or sends anything that the mail does not carry is a victim to the express companies.

What is known as the Moon resolution is pending in the House of Representatives which would render action on a parcels post proposition possible, but there is imminent danger of the Rules Committee strangling the movement because the majority of Congressmen are friends of the express companies. The change proposed is very small, but it would be an excellent means of educating the people into the benefits of the parcels post enjoyed by all countries free from the impositions of express companies.

Defends the Commerce Court.

We have repeatedly called attention to the just decisions rendered by the Commerce Court in railroad disputes, and because that court has tried to be fair towards railroad interests it has incurred the inveterate animosity of certain politicians, particularly the members of the House of Representatives. We are pleased to observe that one leading daily journal takes a decided stand in favor of the Commerce Court receiving justice. A recent issue of the Chicago *Tribune* says, editorially:

"The action of the house in voting to abolish the newly-founded Commerce Court should be very carefully considered in the Senate.

"The Commerce Court was created for very excellent reasons to meet a very plain need. To abolish it before it has had any real chance to demonstrate its usefulness through a reasonable period of years, and especially to abolish it because its first few decisions are not approved, is a crude form of recall not only of decisions and of judges, but of an institution which yet may prove itself of great value.

"The charges against one of the members of the court, Judge Archbald, involving him in relations with a railway, should in no manner affect the existence of the court itself. Should we abolish the Supreme Court if one of its members proved venal?

"As to the arraignment of the Commerce Court by the Commerce Commission, it offers no sound reason for the destruction of its reviewing tribunal.

"The Commerce Court is criticized because it reversed the commission in twenty cases out of twenty-seven appealed. This fact is by no means conclusive of bias. It is fair to assume that the railways appeal their strongest cases. It is also fair as well as wise to wait for a longer period before checking up on advantages. A court worth its salt, a really unbiased court, does not decide by the methods of compromise, giving each side an equal number of decisions. It is sworn to decide according to the law and the evidence. If the Commerce Court is wrong upon the law and the evidence, an appeal to the Supreme Court is pretty certain to correct that error.

"If the Commerce Court has usurped powers there is remedy by appeal to the Supreme Court, or, if that fails, by amendatory legislation.

"In short, none of the objections raised goes to the institution itself, and there remain unchallenged the sound reasons for its creation—namely: to avoid the diversity of ruling necessarily the result of appeals to the regular circuit courts of appeal and to provide a single special court which in due time would become expert in passing upon interstate commerce problems. The commission can hardly be ready to assume that its decisions should be held superior to review.

"It may seem to be good politics for the house to wipe out the Commerce Court, but the Senate should not assent unless the case against the court can be shown to rest on much broader and deeper foundations than a remonstrance against a probably temporary and accidental preponderance of decisions favorable to the railways. If the Commerce Court is to be abolished because a greater part of its decisions in the brief term of its existence have favored the railways, the Interstate Commerce Commission's total record with much more justice may be checked up to discover whether its decisions tend greatly in the opposite direction."

It is needless to say that we heartily endorse every word of the foregoing call for justice, and sincerely hope that it and other demands for fair play may influence the Senate to refuse concurrence in the action of the House of Representatives.

True Function of Education.

If we go back in the history of our language to the first-known use of the word "education," we find that in 1540 it had as its meaning "the process of nourishing or rearing a child or young person." It will be noticed that in this case, as in so many others, a term which may now be regarded as meaning something abstract and psychological, is derived by metaphorical extension from an earlier concrete and physical concept. Yet if the word "education" has gained in breadth since its first use four and a half centuries ago, it has also lost much in depth at least as commonly used. The essence of the word "nourishing" is assimilated; it conveys the idea of the food which is almost easily converted into life-giving blood, and thence, with hardly a pause, into nerves, bones and muscles, to become an inseparable part of our bodies. For one reason or another, we seem to have passed beyond the stage of a simple educational diet which can be thoroughly assimilated; we present either the jaded palates of a worn-out-race, or the capricious appetites of spoiled children. Instead of the educational roast and boiled joints of our forefathers, we toy with highly seasoned entrees which blunt our appetites for the time being, but do not give us the strength for long fasts, the energy for great work, or the physical repose necessary for deep thought.

We shall find, if we keep the idea of assimilation as the primary attribute of all education, that the physical and mental analogies are reasonably close and hardly, if at all, misleading. Mental indigestion from overstuffing, no less than physical indigestion, produces cloudiness of the brain. Mental dyspepsia may follow a diet of too large a variety of elective courses, just as physical dyspepsia may follow over indulgence in highly spiced but non-assimilative foods. In both cases time is an indispensable factor to assimilation; plain food will be most enduring in results; maximum effiiciency will be found in maximum assimilation and minimum waste. Fixed habits are perhaps the most valuable gift we can receive, whether from rearing, from college training, or from that first part of our lives passed in the world of men. Yet granted that we have taken firm hold of essentials, we may pursue cognate non-essentials as an enlightening means of recreation. Every author has his historical background, every science has its borderland, every art has its path of development. Knowledge is the result of profound study; culture is the reward of diligent exploration. With knowledge alone we are the flatlanders, realizing our neighbors to each other, from a juster estimate of our relation to them.

For in our realization of our true relationship to the whole of the outer world lies the benefit of our education. The pure specialist, without sympathy and without comprehension, is simply a machine tool in the hands of a higher order of intelligence. When Mr. Carnegie claimed for himself only the power of acting as a magnet for much abler men, he either meant much more than he said, or said much more than he meant. To utilize ability, to turn it into its proper channels, to mark the time and place when and where one kind of specialized mind should begin and where it should stop to allow the next specialized mind to take up the running, is the function of true greatness. The general in command of armies, the statesman responsible for a party, the captain of industry with success and failure hanging upon his decision, asks no more than that the subordinate whom he chose can convert his ideas into action. "Be bold, be bold, be not too bold," says his modern analogue.

Capital, modern economists are agreed is the crystallized savings which can be lent out to reproduce itself in useful work. It is, in fact, stored energy. In its baldest form, capital represents the wheat saved from last year's crop to enable the laborer to garden next year's crop without dying of starvation while next year's crop is growing. In its broadest sense, education is not capital, but tools.

It is not the knowledge of facts which makes a man educated, but the possession of method. To teach a man to learn how to learn is the true function of education. and to stuff his mind with facts beyond this point is merely to encumber him in pursuing his means of livelihood. It is true that the method of education adopted may, and perhaps should, bear some re-

lation to ultimate ends. The future classical scholar will save himself much annoyance by a diligent study of Greek irregular verbs. The future mechanical or electrical engineer will enjoy an ease, not otherwise procurable, by a through mastery of elementary mathematics. But, still, education is not so much intended for the elucidation of old problems as for the tackling of those that are new. And, as a knowledge of facts without the power of ratiocination is worthless for new ventures, and as every problem which meets us in life is a new venture, therefore, method by itself is everything, and facts by themselves are nothing.

There Is a Man Looking For You.

This is the warning we would pour into the ears of all young men who are ambitious to get ahead and cannot see the rungs of the ladder from their present position. All successful business men and railroad officials are constantly on the lookout for some good, reliable man to take off their own shoulders some of their responsibility. There are very few superintendents who are not watching their conductors, and fewer master mechanics who are not watching their engineers with a view to finding out who would be best to take some position of responsibility if a vacancy should occur. Master mechanics, roundhouse foremen and traveling engineers are watching firemen to discover the best man to promote. To every man we would say, attend to every detail of your business, study to do it better, more economical and easier, and some one else will be taking notes of your actions; they may say nothing about it, but the good is all placed to your credit.

You have been surprised before now, the men themselves have been surprised, to find a foreman or master mechanic, superintendent or train master, asked to take a similar but better position, at more pay, on some distant road, that the man himself knew a little about. He had never thought of seeking employment on that road, but had been attending carefully to the details of his present job; there was a man hunting for him. He had an important place to fill, and he wanted to put in a practical man who knew and studied the details of that business, and when at last he found him in Maine, he opened a higher position for him in Oregon. Do not hunt for the man with the position to give; you will lose him in the crowd. Make every action of your life and work so suspicious of honest endeavor to be an expert at your business, that the man hunter will find you by your acts, your record or your words.

If you have new or different ideas of economy in running, firing, or repairing engines, or of making or using tools, think out the details of your scheme; look at it from all sides, and if you think it fairly novel or in any way better, let it be known; write about it; you may make a mistake; who has not? You may call out pointed criticisms, but you will be learning something, and the man on the watch will count you as a thinking man and ask for your pedigree of results; if they are fair he will ask for you.

Illiteracy.

There are over 8,000,000 people in the United States who can neither read nor write; over a quarter of a million of them in the State of New York. We believe there are very few men on locomotives who cannot read, and hope the few, if there are any, will be all gone before another issue of this paper makes its appearance. Men cannot run locomotives in road service who do not read, and we hope that if there is a fireman in this broad land who cannot read, he will speedily learn. Any man who will try can learn to read ordinary newspaper print and to write his own name in two to four weeks by devoting an hour or so a day to it. There is no possible excuse for a young man not to be able to read. False pride may prevent, but real pride ought to overcome the false. There is no confession more humbling than that of illiteracy. Go to any one you know, old or young, rich or poor, male or female, make your confession and state your determination to get out of the dark and ask for a start. You will not be refused once in five thousand times. If you were pitched into the sea you would try to swim; you are in a sea of darkness. Swim.

Guarding Against the Unforeseen.

This is the engineer's first great duty on the road. This is the duty that keeps his eye riveted to the track ahead, noting every signal and every sign. This is the duty that makes the fireman keep an extra lighted lantern ready for use in case of trouble. It is this duty that makes the careful engineer inspect his locomotive every trip to see if any single bolt or screw shows any sign of weakness. This is the duty that calls for lunch pails as big as a boarding house—there might be a snow blockade or a burned bridge. It is this uncertainty of what will turn up next that makes an engineer's life the nerve-straining one it is. A man walking over the road may expect to find different conditions, but he can stop in a single step, and the risk is only to himself; an engineer cannot stop for a considerable distance; he is going at a rate of speed that is moderate if all is well, and dangerous if anything is wrong; and a hundred lives instead of one, are in his keeping, and depending on his instant ability to cope with any emergency that may turn up. These emergencies are turning up many times a day to every engineer, and that so few signals are disregarded and so few fatal accidents happened from this cause speaks well for the careful guard kept on every detail and the ability of the men in charge to guard against the unforeseen.

Decrease of Revenue with Increase of Expenses.

The business of railway extension is far from being active, but some addition to the country's railway mileage keeps going on through the necessity for finishing work that has been in course of progress. According to the reports of the Interstate Commerce Commission an increase of 2,108 miles in the railways operated in 1911 was made over the mileage of 1910; yet there were fewer employees on the pay rolls in 1911 than there were in the previous year. That came from the homely practice of cutting the robe to fit the cloth. Railroad revenues had been so badly curtailed by the public policy of cutting down rates that the railways were compelled to do everything in their power to keep down expenses with the result that heavier locomotives and heavier trains did the work with fewer employees.

The railroad revenues for 1911 were $27,698,780 less than they were for 1910 in spite of the increased mileage. This cutting down of income along with increase of outgo cannot go on for many years before it will introduce a new era of receiverships. Meanwhile it is comforting to know that in spite of these drawbacks the prospects of the reports for 1912 are full of promise, and many are assured that the darkest hour in the history of railroads has been passed.

Against Carrying Explosives on Railroad Trains.

Calling attention to the fact that it is unlawful to carry explosives in passenger trains, or have them carried as baggage, General Manager G. L. Peck, of the Pennsylvania Lines west of Pittsburgh, has inaugurated a campaign to put an end to the practice of foreigners and others of carrying blasting powder, gum powder and dynamite on such trains, or of including explosives in their baggage.

It is against the law to deliver explosives for transportation by freight without properly packing and marking the same, in accordance with rules of the Interstate Commerce Commission.

Notices to this effect in German, French, Italian and Polish are now being posted by the railroad company at all stations and in conspicuous places in mining districts throughout the territory in which the Pennsylvania Lines operate.

Railway Signaling

It may be said with much truth that like the development of the locomotive engine, the growth of railway signaling has been slow and has engaged the attention of many of the ablest engineers employed on railways. As we stated in last month's instalment of short articles on signaling, it is of real value to the all-round railway man to make himself conversant with the inception and growth of any particular branch of railway work with which he may be interested. In this work some of the employee's publications contain matter that is of real value, and as we already stated Mr. Thomas S. Stevens' contributions to the Santa Fe Employees' Magazine is an excellent example of this kind of work. It has the double merit of clearness and condensation, and we are pleased to make use of some of the terse comments from the source alluded to.

Coming to the consideration of the distant signal as used at interlocking plants, it may be said at the outset that the term distant signal does not appear to have any distinct signal meaning, and the terms "home" and "distant" were used originally to describe signals which were either near

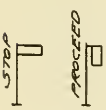


FIG. 9

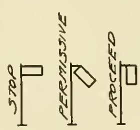


FIG. 10

to the interlocking station or home or those which were at a distance from that place. From a signaling standpoint the home is a stop signal and the distant is a caution signal. The home is placed at a certain point where it may be necessary to stop trains, and the distant at a point where it may be necessary to indicate that the speed of trains must be limited. The interlocked distant signal is one form of the caution signal.

When it was deemed necessary to space trains the first scheme used was a time interval. Signals were erected at convenient points, which were used to stop trains until a certain time interval (five, ten or fiften minutes) had elapsed after a preceding train had passed. This method soon proved to be defective, because the preceding train might have stopped around a curve a short distance from the signal, and the scheme finally was abandoned and in its place a space interval was used. This means that a certain space or length of track must be clear of trains before the stop signal is removed and the proceed signal displayed.

The first spacing signals used were operated manually and were arranged to give stop and proceed indications. At this time a thought began to enter into signaling that signals used for different purposes should be of a distinctive character and with spacing signals, which were taken to mean block clear or block occupied; a distinctive arm was used, with the end pointed or rounded at the will of the railroad. At night no distinction was possible because there were only

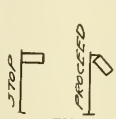


FIG. 11

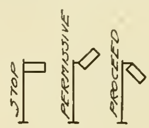


FIG 12

three distinctive colors of lights available: red, green and white.

Red was used for stop and white for proceed, in accordance with the practice obtaining with interlocked signals. For spacing trains the rules say that a certain section of track must be clear of trains before another train can be allowed to proceed, or, to put it in another way, all trains must be stopped unless a given section is clear of trains. The rule for the design of an interlocking plant is that it shall be so arranged that stop signals must be displayed until switches are right for the route over which the train must pass and are properly locked.

At first blocks were long, and, with only stop and proceed signals available, traffic often was badly delayed, so that it was deemed expedient to allow more than one freight train to enter a given section of track. For this purpose a card was first used advising that trains might proceed under control, and later a different position of the arm was designed for this purpose.

Some roads adopted the signals shown in Fig. 9 for interlocking and those shown in Fig. 10 for spacing trains, while others

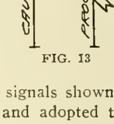


FIG. 13

retained the signals shown in Fig. 11 for interlocking and adopted those shown in Fig. 12 for spacing trains. Most roads at this time retained the fishtail blade, Fig. 13, for the caution signal at interlocking plants.

Thus was provided a distinctive position of the arm (a daylight signal) for what was called permissive block, but it still was necessary to arrange for night signals. We have seen that red was used for stop and white for proceed. Green was the only color left, and this had been used for a caution signal at interlockings. What shall we do with the permissive block signal? Is it really different from the interlocking caution signal? Can the engineman control his train any differently in one case than the other? There is an obstruction ahead in both cases; in one it is a signal at stop, in the other it is the rear end of a train. The engineman may know absolutely or very approximately the location of the stop signal; he will not know anything about the location of the rear end of the train, but in either event he should have his train under control—in the first place because he may not be certain of the way his train will act when the stop signal is definitely located, and in the second because he must be prepared to find the rear end anywhere. It would seem that the use of the caution color (green) was proper and that the permissive signal is really a caution signal after all is said and done.

Later the automatic signal was developed for spacing trains, and other ideas were introduced. The first automatics were operated by air and were semaphore

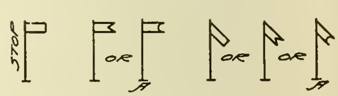


FIG. 14

signals using a square end blade for home signal and a fishtailed blade for distants. Note here that the interlocking names followed when automatics were started. Stop signals became automatic home signals, and caution signals became automatic distant signals. Semaphore signals were expensive to operate in this way and for a time were supplanted by the disc signal which was first used only as a stop signal. The stop indication was given by the display of a red disc, and the proceed by the absence of the disc, red and white being used at night.

It soon was discovered that automatic signals were no different from other automatic devices and were subject to failure, a great deal more so in the first years of their development than they are today, and some rule was necessary to insure that traffic would not be delayed unduly by failures. Since the effect of a failure on the signal was the same as the effect of a train in the block, the rule must be applicable to stop signals generally, and a rule was adopted requiring that trains must stop and after a certain given time interval had elapsed might proceed under control.

Because the disc signal was so different in form from an interlocking signal and so provided a means for the engineman to distinguish between a stop signal he could pass and one he must wait to be flagged by, the disc signal for a long time was recognized as the true automatic signal. The indications were more or less indistinct, and when the electric semaphore signal was invented it quickly was adopted.

A new difficulty arose, however, which was not at first apparent. At the start most of the outlying interlocking plants were operated mechanically, and the form of signal used was easily recognizable, but when power signals came into use for interlockings as well as for automatics it became more difficult for the men to remember which signals were operated under interlocking and which under automatic signal rules. It speaks well for the intelligence of the enginemen to note that very few mistakes were made, but it early was reasoned that some distinctive mark was necessary. Most roads adopted a

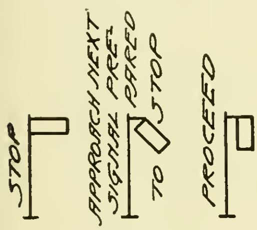


FIG. 15

circular or pointed end blade, the practice varying as each had previously adopted a circular or pointed end blade for manual block purposes. If a pointed end blade had been used on a manual block signal a circular end blade was used on automatics, and vice versa. This undoubtedly allowed the men to locate signals operated under automatic rules, and after once locating them, they could remember where they were. On some roads a letter A was used, sometimes illuminated, to make a further distinction.

The distant signal in automatics seemed to have some special meaning, because the only reason for it to indicate caution was because the next signal was at stop, and this thought resulted in the formulation of another indication, "Approach next signal prepared to stop." The signals used to display this indication are shown in Fig. 14, and it will be noted that, except on a few roads where Fig. 14A was used, they were identical with those used at interlockings. On some roads a three-position signal was used for automatics, as shown in Fig. 15.

Note here the similarity between these signals and those shown in Fig. 10 for manual block. This has been criticized, and this criticism and the need for a distinctive indication for the caution signal will be discussed when the association proceedings are reached.

Wasting Oil and Gas.

We hear a great deal about the duty of the United States to conserve and protect the natural resources of the nation, but there are some lines of waste still flowing that are as lamentable as was the practice of ruthlessly burning down valuable wood to convert forests into farm lands. Enormous waste has characterized the oil industry of California for a variety of reasons, says the San Francisco *Call*. There has been a lack of storage capacity and pipe lines, but these defects are being corrected. The greatest loss has been in the natural gas that has been suffered to escape. There is, for example, a well in Kern county that is blowing off into space some 74,000,000 cu. ft. of gas every day in the year. That well by itself would supply three cities as big as Los Angeles and leave a surplus. The daily consumption of Los Angeles is stated to be 20,000,000 cu. ft. This tremendous gas well is only one of many whose output is allowed to go to waste. The flow of gas comes with such force that the operators have so far been unable to control or turn it. The roar of the escaping gas can be heard for miles. Some of these wells have been wasting gas for years. It is proposed now to pipe the gas across the mountains to Los Angeles. There are some mechanical difficulties in the way, but these will surely be got under control. There is too much money in the product to suffer it to be wasted.

Where Railway Unrest Is Needed.

People who are familiar with the Bible will think of Mesopotamia and Syria as a land flowing with milk and honey. From a report made by the American consul at Aleppo the country remains in about the same condition as it was in the time of Abraham, and the people never have been disturbed by the ideas we call progress.

While practically all of the land is tillable, and of a very fertile nature, in the immediate environs of the city of Aleppo there are great stretches of land now cultivated in the most primitive manner. Plowing is done with a yoke of oxen or buffaloes, hitched to a wooden plow with a straight point, which merely scratches the surface of the earth to a depth of 4 or 5 ins. The harrowing, or more properly dragging, is done by drawing a heavy piece of timber crossways over the ground. This prepares it very poorly for the sower, who scatters the grain broadcast by hand, after which the ground is again dragged by the use of the same implement.

Reaping is accomplished by hand sickling, after which the grain is thrashed out by stacking the straw in a low circular pile, and driving around on it an ox hitched to a flat sled with sharp stones driven into the bottom. After the straw is cut fine it is pitched in the air, permitting the wind to blow the chaff away, when the grain is gathered from the ground, always with a greater or less quantity of stones and other foreign substances. All other crops are cultivated in similarly primitive ways.

Prodigeous Heat Energy in a Match.

Very few people have any idea of the enormous power represented by the burning of a fire of a gas jet or anything else representing the act of combustion. Scientists have a measure of heat called the heat unit, which is 778.3 ft. lbs. and represents the volume of heat required to raise one pound of water one deg. Fahr. One pound of coal in burning to carbon dioxide releases about 12,000 heat units, representing close on ten millions foot pounds, or sufficient energy to raise one ton weight 500 ft.

A writer in the New York *Evening Sun* makes this illustration of the energy represented by the burning of a match: The energy of combustion released by a single match in burning could heat 7,500 times its weight of water one deg. Fahr. Furthermore, if we consider this heat energy as transformed into mechanical work, we find that it would suffice to lift the match some 1,100 miles high against gravity.

If we take the match to weigh, as it does, about the 100th part of an ounce, this energy would suffice to lift a pound some 3,630 ft. high. In other words, the burning of a single match supplies energy sufficient to lift a mass weighing one ton nearly two feet from the ground.

Smoke Prevention in 1832.

"What our railways were doing eighty years ago," is the subject of interesting notes published in the *Railway and Travel Monthly* for June. One note says:

"A certain Baron Drais, of London, submitted an invention for the prevention of smoke being emitted from the funnels of locomotives, for which he expected to be rewarded. He was, however, informed that the nuisance of smoke from engines had been already abolished.

"That was in 1832, years before railways were informed that they should burn coke in their locomotives or devise some effective means of abating the smoke nuisance which was becoming an intolerable evil."

It will thus be noted that history repeats itself. Commissions are established in some of our cities for abolishing smoke, but the philosophic mind realizes the fact that wherever there is fire there will be some smoke. The evil is being lessened.

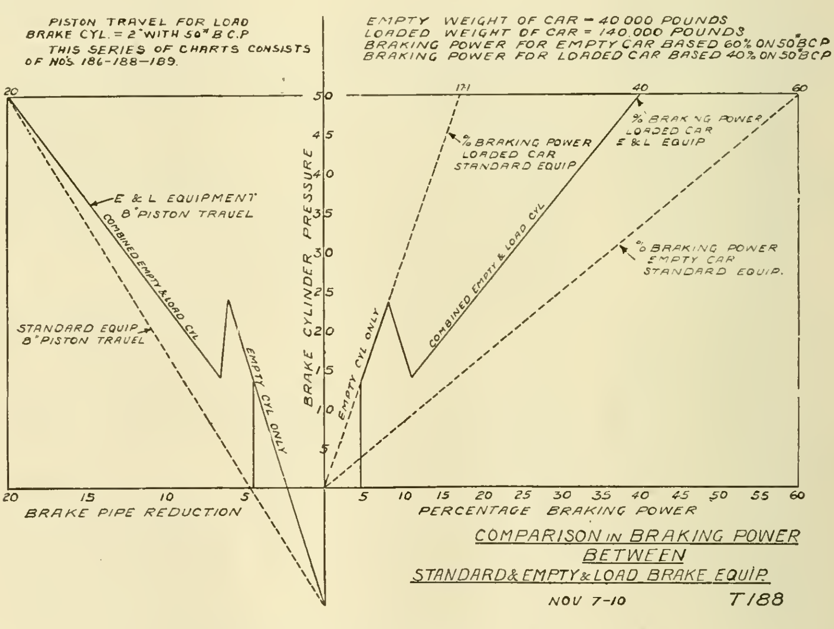
Air Brake Department

Foundation Arrangement Empty and Load Brake.

One of the serious problems of railroad operation is the transportation and control of traffic on heavy grades, and modern motive power has solved the problem of ascent, but the earning power of railroad equipment is largely curtailed by the fact that the present type of brake is unable to safely control trains of the same weight descending, that the locomotives can handle ascending the grade.

Uniform retardation is of secondary importance only to safety in operation, In the design of a brake that will produce uniform retarding effect upon empty and loaded cars alike it must be understood that the leverage phase of the question is definitely fixed by the light weight of the car, and that we now have considerable difficulty in securing a sufficiently low leverage to provide ample shoe clearance; and it must also be understood that in the ordinary method of brake installation a 16 or 18-in. brake cylinder would be required to bring the loaded braking power of the 100,000-lb. capacity car up to the power developed when the or 20-lb. brake pipe reduction from 110 lbs. pressure produces no more brake cylinder pressure than the same amount of reduction from a 70-lb. brake pipe pressure.

It is now apparent that a practical and efficient empty and load brake must be designed and operated without any material addition to, or increase in, the total leverage ratio, pressure per square inch employed, or volume of air pressure necessary to operate the brake, and this on the face of it seems impossible when it is assumed that we already obtain



CYLINDER PRESSURE AND BRAKING POWER DIAGRAM.

and the only way equal braking power throughout a train can be obtained is either to haul all loads or all empties, or provide means whereby a relatively proportional braking power can be utilized on the loaded car.

The article on requisite braking power sets forth the difference in braking power on empty and loaded cars when they are equipped with the standard brake and the damage to lading and equipment and the number of break-in-two's with mixed trains on level track shows to a certain extent the results of the inequality of retarding effect.

car is empty. Therefore, as the ratio of leverage now employed leaves a very narrow margin for shoe clearance, and the use of 16 or 18-in. brake cylinders would require volumes of auxiliary reservoir pressure that it would be practically impossible to maintain on long trains, neither of the methods can be considered.

The problem of charging the rear car brakes in present-day service has been dwelt upon at length in these columns, and to secure the necessary braking power for the loaded cars by means of increased air pressure is also impractical, as our readers are well aware that a 10 something near the maximum efficiency of the present type of brake and know that any design of brake must operate in perfect harmony with the millions of dollars' worth of brakes now in use. Mr. Turner, however, did not realize the impossibility of the situation, but with his associates developed an "empty and load" brake that does not depend upon any of the before-mentioned undesirable features, and has already proven a remarkable solution of a complex problem.

We will not at this time dwell upon the advantages of this brake either in grade work or level track service. but, judging

from its satisfactory performance, it will shortly become the standard freight car brake, and we take pleasure in presenting the general arrangement of the equipment and a chart which graphically illustrates its efficiency.

The equipment consists of two brake cylinders, a four-compartment reservoir, a slightly modified triple valve of the K type, and a change-over valve. The brake is manually turned into load position and cuts itself out automatically upon a depletion of pressure unless locked into the load position. The empty cylinder alone operates and in perfect harmony with other brakes when the car is empty, and when loaded both cylinders operate after a predetermined reduction in brake pipe pressure takes place.

The large compartment or auxiliary reservoir portion is of the standard size for 10-in. brake cylinders, containing 2,440 cu. ins. of space, and the additional stored volume for the load cylinder contains but 550 cu. ins. space, which is made possible by a clever leverage arrangement that permits of but 1 or 1½ ins. piston travel for the load cylinder, this power being transmitted through the regular empty car leverage. The construction of the valves, their operation and the use of the small compartments of the reservoir will be explained in future issues by means of diagramatic views.

In connection with the view of the general arrangement is a chart showing a comparison of braking power developed between the standard and empty and load brake. The left side of the chart shows brake pipe reduction and resultant cylinder pressure, and the right side the result in percentage of braking power.

The chart will require no lengthy explanation; the drop in cylinder pressure is designed to occur as the load cylinder comes into operation, as doubling the piston area at this instant necessitates halving the pressure to maintain approximate uniformity of braking power.

Requisite Braking Power.

Basing the percentage of braking power on the light weight of the freight car when equipping it with the air brake, makes no provision for an adequate braking power when the car is loaded and while the added weight of the load could not be correctly termed as unbraked weight, it does lower the percentage of braking power obtainable in a direct proportion to the increase in the weight of the load carried.

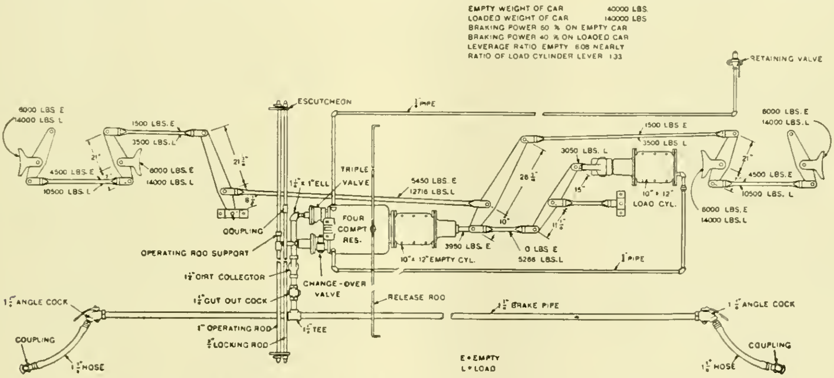
This is generally accepted as necessary to prevent the liability of wheel sliding when the car is empty and the speed low, and even if the loaded freight cars are brought to a stop in apparently satisfactory distances on level track, it does not indicate that the loaded car can always be stopped on a descending grade with the air brake alone, as the drifting car will be stopped by atmospheric resistance and its internal friction when on the level track, but those forces alone are ineffectual when the car is on the descent.

Now the work an air brake is capable of doing in grade service is always a variable quantity and the cause of brakes failing to hold a train on a grade becomes merely a matter of conjecture if it is always assumed that the brakes, when in good condition, should hold the train regardless of speed, load or grade, and to ascertain the braking power required to hold a train of cars in control on any grade necessitates an accurate analysis of the factors entering into each individual case, but an approximate estimate of the required power is readily found by a simple calculation that involves only the per cent. of grade and the average co-efficient of friction obtained.

This problem resolves itself into the consideration of two forces, one exerted by the car in an effort to descend the grade, the other the braking effect tending to prevent the descent. The first force is, of course, measured by weight of car and per cent. of grade, and in this connection it may be of interest to note that the weight of the car multiplied by the per cent. of grade equals the force tending to accelerate the car down the grade. This is proven by experiments conducted to determine the velocity acquired by falling bodies, and when bodies were made to roll down smooth and variously inclined planes the motion was uniformly increased with the increase in the height or incline of the plane.

A car on a grade is a rolling body on an inclined plane and its weight or gravity is exerted in two directions, one force pressing against the surface of the plane the other tending to produce motion down the plane, and as velocity and weight increase uniformly with the incline of the plane, on a one per cent. grade, that is, where the inclination of the plane is at a ratio of 52.8 ft. to the mile, one per cent. of the weight of the car would be exerted as force tending to roll down the grade.

If on a two per cent. grade, or a descent of 105.6 ft. in each mile traversed, the descending force would be two per cent. of the weight, hence, car weight × per cent. of grade = accelerating force due to grade.



FOUNDATION ARRANGEMENT, EMPTY AND LOAD BRAKE.

The opposing force set up by the application of the brake, which acts to check the descent of the car, is measured by percentage of braking power, co-efficient of friction and brake rigging efficiency and multiplying the first named factor by the second, and the product by the brake rigging efficiency gives a figure which is the force of retardation in per cent. of the car weight. This multiplied by the weight of car gives the retarding force in pounds.

A standard practice recommended by the master car builders is the employment of a braking power for freight cars that will equal 60 per cent. of the light weight of the car based upon a 50-lb. brake cylinder pressure.

A number of air brake demonstrations have proven that the average co-efficient of friction obtained is not over 10 per cent., that is, the pulling effect of the shoe

on the wheel does not average over 10 per cent. of the pressure forcing the shoe against the wheel, and other investigations disclose the fact that the loss encountered in transmitting to the brake shoes the power developed by the brake cylinder is sometimes as high as 20 per cent. of the total power developed on a passenger car, but on a freight car the lighter and simpler brake gear shows a loss of but about 5 per cent. of the power developed by the brake cylinder, therefore the brake rigging efficiency may be taken at 95 per cent.

As an example, 60 per cent. braking power multiplied by 10 per cent. co-efficient of friction multiplied by 95 per cent. brake rigging efficiency is $.60 \times .10 \times .95 = .057$ or 5.7 per cent., which multiplied by the weight of the car is the actual force of retardation under the assumed condition.

Now that we know the accelerating force due to grade and the braking power available for checking the descent, a mental calculation indicates that a 5 per cent. or 6 per cent. grade is reached before the accelerating force will overcome the retarding force when a 60 per cent. braking power is employed, but it will occur to the reader that this percentage of braking power can be developed only on the light or empty car and when the car is loaded we face an entirely different proposition. Let us assume that we have a 40,000-lb. car loaded with 100,000 lbs. weight on a 2 per cent. grade and wish to know the braking force required to equal the accelerating force, and by this we mean a braking force that will not decrease or permit of an increase in the speed of the car.

When those forces are equal we have the following equation:

Accelerating force due to grade = Retarding force due to braking power,

or

Car weight × per cent of grade = Car weight × braking power × efficiency of brake rigging × co-efficient of friction.

Dropping the common multiplier, car weight, and transposing the equation leaves us,

$$\text{Per cent. of braking power} = \frac{\text{Per Cent. of grade.}}{\text{Co-efficient of friction} \times \text{brake rigging efficiency.}}$$

and using the average figures we have mentioned we have,

$$\text{Per cent. of braking power} = \frac{.02}{.95 \times .10} = .21, \text{ or 21 per cent. braking}$$

power will be required to prevent any increase in the speed of the car. Now on the empty car we have 39 per cent. braking power left with which to stop the car, or train, which is the same thing if all cars are braked and empty, but with the car loaded to its capacity of 100,000 lbs. the total percentage of braking power obtainable is 17 per cent., as the 24,000 lbs. braking power is 60 per cent. of 40,000 lbs., but is only 17 per cent. of 140,000 lbs., and as a braking power of 21 per cent. is required to equal the accelerating force due to a 2 per cent. grade, it is evident that if but 17 per cent. is obtainable this car cannot be controlled with the air brake alone on a 2 per cent. grade, or rather, either empty cars or lighter loaded ones must increase the total percentage of braking power on the train above this figure or the use of the hand brake is necessary to add sufficient braking power to hold the train in check.

As train resistance was not taken into consideration, the 21 per cent. braking power required is slightly reduced, but the reduction is largely offset by the lowering in the co-efficient of friction due to the length of time the brake is applied, and in order to make this calculation very easy to remember, the factor, brake rigging efficiency can be considered as offset by journal friction and dropped out, leaving per cent. of grade ÷ co-efficient of friction = braking power required to equal acceleration due to grade. This is approximately correct and involves only a very simple mental calculation to find this required per cent. of braking power.

The problem of properly controlling loaded trains on long grades is one of obtaining sufficient braking power in proportion to the total weight of the train. When the difference in weight of empty and loaded cars is as much as three or four times the weight of the empty car, the application of the standard brakes is fundamentally wrong because the brake cannot provide for the load, which may compose as much as 75 per cent. of the train weight.

The solution of the problem demands that the load must be considered as well as the car itself, otherwise an adequate braking power for loaded cars cannot be obtained.

Piston Travel Chart.

In connection with the small chart showing the variation in braking power due to unequal piston travel we wish to invite attention to a shock producer over which the engineer has absolutely no control whatever.

As we consider the problem of furnishing an adequate braking power for the loaded as well as the empty car it may be well to first note the chart in question.

Variation in piston travel varies every operation of the brake so far as developing brake cylinder pressure is concerned and it also varies the time required to obtain the expected braking power and furthermore, the variation in travel may entirely change the percentage of braking power that should be expected for a given reduction, as it is possible to obtain several times as much braking power on one car as on another in the same train and from the same figure of brake pipe reduction in each case, and this is due to variation in brake cylinder piston travel alone.

We wish to state positively that the empty and load brake is not an automatic slack adjuster and it is not intended for the express purpose of compensating for, or counteracting the effect of, unequal piston travel, but if uniformity in retarding effect is essential to successful air brake operation it is easy to see what unequal piston travel means to brake manipulation in the way of producing shocks to the train.

Unequal piston travel is, of course, the rule rather than the exception, and upon inspection the chart will manifest the absolute necessity for the nearest practical approach to uniformity in travel if a measure of the results advocated in instruction cars or rooms are to be attained.

This chart shows that a 5-lb. brake pipe reduction on a car having 4 ins. brake cylinder piston travel, results in 350 per cent. more braking power than is developed on a car having 8 ins. piston travel and at the same time on a car having 12 ins. travel, the 5-lb. reduction results in 150 per cent. less braking power than on the car with 8 ins. travel.

A further reduction tends to reduce the variation and at 12 lbs. brake pipe reduction the 4-in. piston travel develops 100 per cent. more braking power and the 12-in. travel 50 per cent. less than the standard 8-in. travel.

Following is a very interesting table which shows the result that would be obtained in service with a 10-lb. brake pipe reduction were there no losses of any kind. Leakage will make a difference of from 2 to 3 lbs., and the effective braking power is computed from a leverage designed to give 60 per cent. braking power based on 50 lbs. cylinder pressure, which is now recommended for steel cars, and 8 ins. piston travel is usually taken as a standard for freight service.

The table then shows the variation in effective braking power as a result of the different lengths of piston travel and a comparison of the power developed, whether greater or less than that resulting from the 8-in. travel.

10-LB. BRAKE PIPE REDUCTION.

Piston Travel	Cylinder Pressure	Effective Braking Power	Comparison with 8-in. Travel.	
ins.	lbs.	per cent.	per cent.	
4	52½	63	130	Greater
5	41	49	78	"
6	33	39½	44	"
7	27½	33	20	"
*8	23	27½	...	....

Piston Travel	Cylinder Pressure	Effective Braking Power	Comparison with 8-in. Travel.
ins.	lbs.	per cent.	per cent.
9	19	23	16½ Less
10	16	19	31 "
11	13	15½	44 "
12	11	13	53 "

The following table will show the equalization pressure between an 8 x 12 brake cylinder and standard cast-iron auxiliary reservoir from a 70-lb. brake pipe pressure.

The equipment is of the combined type, that is, 50 cu. ins. space is allowed for cylinder clearance and no losses whatever are considered:

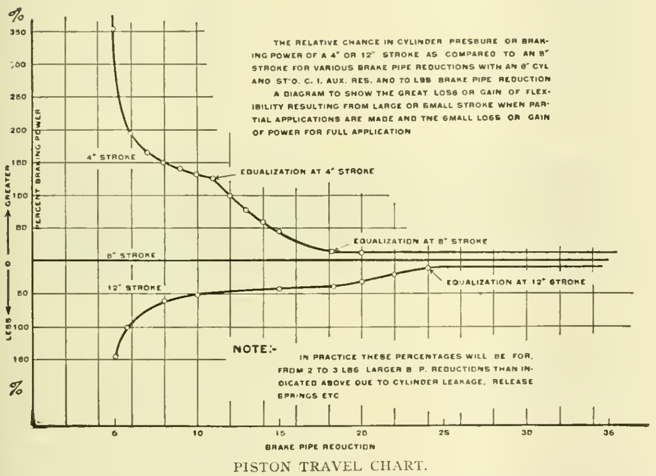
Piston Travel	Equalization Pressure	Brake pipe Reduction
4 ins.	59 lbs.	11 lbs.
5 "	57 "	13 "
6 "	55 "	15 "
7 "	53½ "	16½ "
*8 "	51½ "	18½ "
9 "	50 "	20 "
10 "	49 "	21 "
11 "	47 "	23 "
12 "	46 "	24 "

In the latter table the amount of brake pipe reduction necessary to produce equalization of pressure between the auxiliary reservoir and brake cylinder furnishes food for reflection. As an example let use consider two empty cars of the same light weight, braked at 60 per cent. braking power based upon 50 lbs. cylinder pressure, one car having 5 ins. piston travel and the other 11 ins.

The table shows that a 13-lb. reduction will equalize the pressure at 57 lbs. on the car with 5 ins. travel while 23 lbs. reduction is required to obtain the maximum braking power on the car with 11 ins. travel. Not only is 10 lbs. of brake pipe pressure wasted on the car with the short travel and a final difference of 10 lbs. in cylinder pressure obtained, but the higher pressure on the short travel is obtained in just about one-half the time required to secure full pressure on the 11-in. travel.

The case of 60 per cent. braking power based upon 50 lbs. cylinder pressure represents 68½ per cent. braking power and 47 lbs. cylinder pressure represents 56½ per cent. which is in itself a considerable variation in retarding effect if the shortest possible stop in imperative, but a starting variation is shown if but a 13-lb. reduction of brake pipe pressure is made.

This reduction, as previously mentioned, would give 57 lbs. pressure or 68½ per cent. braking power with 5 ins. piston travel, but on the car with 11 ins. travel would yield only 20 lbs. cylinder pressure and at the same percentage of braking power, that is, 1.2 per cent. per lb. of cylinder pressure, would give 24 per cent. braking power on the car or a difference that will be appreciated by a study of the first table.



PISTON TRAVEL CHART.

None of the foregoing remarks are intended to have any reference whatever as to the amount of brake pipe reduction that should be made during a brake application, as that happens to be a very broad subject, but it is intended to state that the best operation of brakes can only be secured by maintaining uniform piston travel on all cars, and while there are exceptions in most all cases this is assumed for trains of all empties or all loads or the use of the empty and load brake on loaded cars in mixed trains, but where the empty and load brake is not used, mixed trains with empty cars or the rear end can be handled much more successfully if the piston travel is short on the loaded cars and unusually long on the empty cars. The table will show that short travel will produce greater braking power on the loaded cars and long travel less on the empty cars, but uniformity is the essential feature in air brake operation and the empty and load brake will provide an adequate braking power on the loaded car.

It may also be observed that the amount of brake pipe volume and pressure required to accomplish a release of brakes under the influence of unequal piston travel varies in proportion to the difference in auxiliary reservoir volume after the full application, the table shows that about 49 lbs. brake pipe pressure will be required to release the brake with 11 ins. travel, while about 61 lbs. pressure will be required to move the triple valve on the car having 5 ins. piston travel.

A Marvelous Invention.

At a social gathering in Pittsburgh Mr. William Gibson said:

"The year of our Lord 1871 marks a period in the life of our genial and aged but ever youthful host, and, in speaking for Pittsburgh on this unique and delightful occasion, it may not be inappropriate to tell you that the same year marks my introduction, not to Pittsburgh, but to the name of Pittsburgh, and to the name of one who has done much to make Pittsburgh great. In 1871 I was a schoolboy in Scotland, and I well remember hearing my elders speak of an American gentleman then visiting Scotland. He had fashioned a marvelous invention, then being introduced on Scottish railways—a strange device, which, as if by magic, or by some subtle and black and Satanic craft, was said to make rushing trains stand still. It is a matter of great regret to me, as I am sure it is to our host, and to every member of his party, that this distinguished gentleman, this creative genius, who is still, and long may he be, preserved to Pittsburgh, and the world, is not with us tonight—a gentlemen, the mere mention of whose name, in such a gathering as this, is sufficient to elicit a manifestation of respect and of grateful and hearty appreciation. I refer to Mr. George Westinghouse."

Elephants Hauling Automobiles

It would naturally be supposed that no animal could be used for transportation purposes where high-powered automobiles failed, but the *Literary Digest* relates a case of this kind which happened in India. A great tiger-hunting expedition was arranged by an Indian Maharaji, and the party came to a hill which the automobiles conveying the party could not climb. That did not delay the expedition. Elephants were in waiting, and those animals were hitched to the automobiles and successfully hauled them up the steep hill road.

Electrical Department

Control for Railway Motors.

In our article last month we described and illustrated the methods used in changing the motors from series to parallel. There is the "L" controller which opens the circuit when changing over, and the "K" controller which cuts out or shunts one pair of a four-motor equipment. With the open circuit connections of the "L" controller there is felt a sudden jar when the change from series to parallel takes place as momentarily there is no flow of current, and the speed of the car or train is reduced. The motors are then connected to the power in parallel and the sudden increase of speed is perceptible.

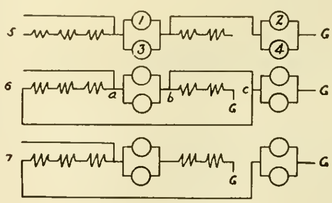
The conditions are greatly improved with the K controller as there are two motors of a quadruple equipment that are working during this period so that the momentum of the train is not decreased. The latest types of "K" controller use what is known as the "bridging" system, and we will describe just what connections are made in the controller and the principle of operation.

Fig. 4 shows how this change is effected. We have shown only the three positions during the change from series to parallel, and not any of the other positions which are resistance points and similar to those shown in Fig. 3. The resistance is divided into 2 parts and in full series all of this resistance is cut out as shown, position 5. On the next step, position 6, the resistance is connected between the source of power or "line," as it is called, and ground, in parallel with the motors. Thus the 4 motors are across the 600 volts and also the resistance, so that the point midway in the resistance and the point between the two pairs of motors are at the same voltage and each pair of motors can be connected across the 600 volts with one group of the resistance in series without a sudden surge of current and without opening the circuit or shunting a pair of motors. Position (6) shows this arrangement. The current divides at (a), passing through the two pairs of motors to ground (G) as one circuit, and through the two sets of resistances to ground as the other circuit. These two circuits are tied together at the same voltage point as shown by the connection (b-d). A study of this diagram shows that the only thing necessary to put the motors in the parallel position is to open the connection at (b-d) and this is what the controller accomplishes. The motors are then as position 7 and the remaining points on the controller cut out the resistance step by step. With the "hidging" system very smooth acceleration is obtained.

2,400-Volt Direct-Current Railroad Electrification.

The electrification of the Butte, Anaconda and Pacific Railroad will be watched with a great deal of interest by the electrical engineers over the country, as the power to be used is 2,400 volts direct current, a voltage nearly double that used heretofore. For many years 600 to 700 volts direct current was used. About five years ago the General Electric Company recommended and equipped a road with 1,200 volts direct current (D. C.) which was considered by many an experiment but which proved most satisfactory and adaptable to many electrifications.

The General Electric Co. is now advocating 2,400 volts D. C. and is equipping



K-CONTROLLER.
BRIDGING CONNECTION.

30 miles of main line single track between Butte and Anaconda, Mont. The total track mileage, including sidings, smelter tracks, etc., is approximately 114 miles. The service over this section will be heavy; the Chicago, Milwaukee and Puget Sound Railroad use the tracks for 16 miles and trains of ore and lumber weighing 3,400 tons will be handled.

To perform the service 17 locomotives will be required each weighing 75 tons, two of which will be geared higher for passenger service. Two substations will be built, one near Butte and the other at Anaconda, 26 miles apart, supplying power to overhead conductor.

The advantages gained in using high voltage is that fewer substations are required and thus the cost is lowered. As the voltage increases, however, with direct current, it is more difficult to insulate the motors, switches, etc. It is this fact which will cause everyone interested to follow the operation to determine what will be the reliability, cost of maintenance, etc., of these locomotives. If this electrification is a success the field for railroad electrification should be greatly increased.

The Gas-Electric Car.

The gas-electric car is essentially a locomotive and car combined in one unit. That is, it is a self-propelled car, and uses gasolene for fuel. This type of car is different from the McKeen gasolene car as the gas engine is not connected directly to the axles of one of the trucks as is the case with the latter, but is direct connected to an electric generator which supplies electricity for driving motors geared to the axles.

Our illustration shows one of these cars which is operating on the Frisco System, and which was built by the General Electric Company. This car is one of many which are in successful operation over a number of railroads in this country. They are especially suitable for operation on branch lines with small amount of travel where steam is operated at a loss. The operating expenses are reduced and the traffic is increased through the greater pleasure of traveling and absence of smoke and cinders.

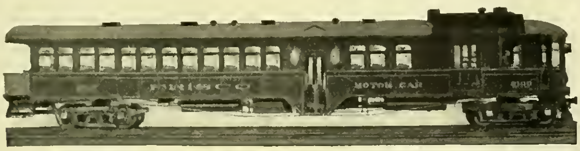
The generating unit is located above the floor line of the cab, free from dust and dirt and under immediate observation of the engineer. It consists of an 8-cylinder 4-cycle gas engine, which is direct connected to a 600-volt, electric generator. The starting of the engine is effected by compressed air taken from the main reservoirs of the air brake system, which are built with surplus capacity for this purpose. The main air compressor is driven from the crank shaft of the main engine and is fitted with an automatic governor. To provide an initial charge of air for starting an auxiliary equipment is provided, consisting of a small gas engine connected to a single-acting air compressor and to a small electric generator for the electric lights.

Two railway motors, 100 horse power each, are mounted on the axle of the forward truck and receive electric power from the main generator. The motors are controlled through a controller and are connected first in series and then in parallel. Besides the two speeds when the motors are in series and parallel position, a wide variation of speed from start to maximum is obtained by voltage regulation; the speed of the gasolene engine and electric generator remaining constant, irrespective of the speed of the car, and delivering its maximum power, a feature of great advantage on grades.

We will explain more fully just how the car is operated at any speed desired by means of this "voltage regulation." In an electric generator the voltage generated depends on the speed of rotation and on the strength of the fields. If the speed or rotation of the armature is constant then the voltage can be raised or lowered by varying the amount of current flowing through the field coils. The current through these coils is regulated by the "field rheostat," so called, which is a resistance with many steps inserted in series with the field coils. This is the method used in the gas-electric car. The electric generator is rotating at constant speed and the variation in voltage is obtained by changing the amount of resistance in series with the field coils of the generator. It is accomplished by a single handle on the controller and the resultant speed changes of the motors produce a smooth and rapid acceleration. By this method no resistance is required in the motor circuit as on a trolley car and there are no change of gearing required.

The reversing of the car is accomplished by changing the motor connections, so that it is not necessary to stop the engine and same always rotates in the same direction. This method of reversal is of extreme advantage in the case of emergency. The car can be brought quickly to a stop if the brakes fail, for the motors can be reversed, and a low voltage applied to them which will slow down the car gradually without damage to any of the apparatus.

The advantages of the gas-electric car over the straight gasolene car should be clearly seen. The engine in the former always rotates in the one direction, and the simple and substantial control by means of electricity and electric motors replaces gearing and clutches. Years of experience have demonstrated that there is no piece of apparatus less liable to derangement than the railway motor built for heavy high speed traction work.



GAS-ELECTRIC CAR ON THE FRISCO SYSTEM.

Electricity on Railroads.

Mr. E. M. Herr, President of the Westinghouse Electric and Manufacturing Co., in an address at the Railway Guild Dinner, May 14, 1912, discussed the application of electricity to railroads.

"We are now living in the age of electricity with the telephone, electric lights and electric motors, and it is a curious fact that the steam railroad, which has made such rapid progress and has done the most to advance civilization has thus far benefited least by the development of electricity; but it is certain that before many years it will, as a whole, be a greater user of electricity than any other industrial class.

"At the beginning of electrical development the power plant was crude, consisting of a dynamo connected by a belt to some kind of an engine. This apparatus was followed by larger dynamos, more efficient steam engines until the modern steam turbine and immense generators were reached. It was the practice for each large user of power to build his own power plant. The cost of operating several moderate size power houses separately is far greater than the cost if all of these separate powers were combined into one, and large central power houses are in existence today and more are building. How does this affect the railroads? It gives the railroads an opportunity to obtain power at such low costs and reliability from the modern centralized power plant that the field for the advantageous use of the electric locomotive will be enormously extended. The railroad can buy electric power delivered on their lines, instead of coal, and be saved the large capital expenditure required for the installation of power plants.

"Electric locomotives were first used in terminal work because of the nuisance and discomfort to passengers and others of steam power. Many benefits, not at first apparent, has developed and it is becoming evident that these advantages are so great that in the future only electricity will be considered for a large terminal in a large center. By the use of electricity it is possible to establish a great railway terminal without annoyance or discomfort to the people and without loss of valuable land for building purposes. Moreover, the electric locomotive enables the capacity of a terminal to be greatly increased owing to the greater rapidity of its movement over that of a steam locomotive and to the fact that the electric locomotive does not have to be turned, coaled, watered, have fires cleaned, nor its boiler washed.

"All of these advantages may be conceded, but objection may be made as to the high cost which may seem prohibitive. True, the first cost is higher but there is a large saving in operation by electricity. This is not the only, or indeed the chief reason for the change. Electricity makes possible the doing of other and better work, and of obtaining results not in any way possible with steam power. When the railroads can buy electric power metered on their lines, at such points as they desire to use it, which will be furnished from large centralized power plants so arranged as to make failure of supply practically impossible, and at a cost of but a fraction of the cost of power for a steam locomotive, then the use of the electric locomotive will be so widely and rapidly extended as is now not dreamed of, nor under present conditions economically possible.

"There is no longer a question of whether electricity can do the work of broadening, extending and improving the very admirable performance of the modern steam locomotive. This has been amply demonstrated. The question to be answered in any specific case is purely the economic one of will it pay. Every railroad officer should keep in touch with the more general and commercial features of electrical development as relates to railroading, for only by so doing will it be possible for him to intelligently pass upon the many recommendations which will come before him as one of the class of the greatest users of electricity and electrical appliances in the industrial world."

Westinghouse Outdoor Type Transformer.

Many times the amount of power to be used at a certain locality does not warrant an expensive installation, and transformers of the outdoor type are particularly applicable. The cost of a building is eliminated, the transformers being placed outdoors on a platform supported by a few poles. Many electrical transmission companies now realize there is a profitable field for the sale of electric power to small consumers. These transformers are built for voltages up to 110,000.

Erie Equipment.

The Erie Railroad has ordered from the Westinghouse Elec. & Mfg. Co., two quadruple equipments for operation on their single-phase electrification switch from Rochester, N. Y.

The meanest form of cheating that we are familiar with is by false weights and measures. In most countries the punishment falls far short of the offense, but Russia has recently given a good example of how to punish this crime. The Irkutsk district court gave decisions depriving forever to participate in any kind of trade persons convicted of using false scales.

Mammoth Mallets for the Virginia Railway

Four of the most powerful locomotives ever constructed have just been completed by the American Locomotive Company for the Virginia Railway. With a tractive effort rated at 115,000 lbs. and a total weight of engine and tender amounting to 752,000 lbs., they may properly be said to be in a class by themselves. The Mallet type of locomotive has been in service on the Virginia Railway for several years, and almost every year an increase in the size of the locomotives has been made to meet the rapidly increasing traffic which necessitated heavier loads. It may be added that the crucial point on the railway is a portion between Elmore and Clark's Gap, on the Deepwater division, a distance of about 14 miles, nearly all of which is on a 2.07 per cent. grade with maximum compensated curves of 12 degs. The trains have been operated over this grade with one Mallet of the lightest class at the head, and two of the heavier locomotives as helpers. With this power, the maximum train over the mountain averaged 3,340 tons. With two of the new locomotives as helpers and one of the older class having 92,000 lbs. tractive power, making a combined tractive force of 332,000 lbs., it is expected to take a train of 4,230 tons over the grade.

Apart from the enormous size and weight of the engines, the design represents the builder's ordinary practice which has been frequently described in our pages. Several new features, however, are found in the design and construction of the boiler. One of these is the arrangement of the fire brick arch employed. It consists of a combination of the Security and the Gaines brick arch. This gives a largely increased firebox volume, although the grate area, 99 ft., is less than that provided in other large Mallets constructed by the same builders.

The grates are power operated—the Franklin Railway Supply Company's power grate shaking system being applied. They are composed of six sections, and the operating system is so arranged that any one section can be operated alone if desired.

Following the builder's latest approved practice for this type of locomotive, the engines are equipped with superheaters. These are of the fire tube, double loop type, and are contained in 48 flues 5½ ins. in diameter.

Vanadium steel has been extensively used for those parts which are subjected to the greatest strain. These include engine frames, crossheads, driving wheel tires; driving, engine trailing and tender truck springs, main driving axles, main crank pins, and piston spiders.

The following are the principal dimensions of these locomotives:

Track gauge, 4 ft. 8½ ins.

Wheel base—Rigid, 15 ft. 6 ins.; driving, 42 ft. 1 in.; total, 57 ft. 4 ins.

Weight in working order, 540,000 lbs.

Heating surface—Tubes and flues, 6,350 sq. ft.; firebox and arch tubes, 410 sq. ft.; total, 6,760 sq. ft.

Superheating surface, 1,310 sq. ft.

Axles—Driving journals, main and other, 11 x 13 ins.; engine truck journals, 6½ x 13 ins.; trailing truck journals, 6½ x 13 in.; tender truck journals, 6 x 11 ins.

Boiler—Type, conical connection, O. D. first ring, 100 ins.; working pressure, 200 lbs.; fuel, soft coal.

Firebox—Type, wide; length, 174 ins.; width, 109 ins.; thickness of crown, ⅜ in.; tube, 9/16 in.; sides, ⅜ in.; back, ⅜ in.; water space, front, 5½ ins.; sides, 5 ins.; back, 5 ins.

Crown staying, radial.

Tubes—Material, seamless steel, No. 334; diameter, 2¼ ins. O. D.; length, 24 ft. 0 in.; gauge, 11.

Flues—Material, seamless steel, No. 48; diameter, 5½ ins. O. D.; gauge, 9.

Tube spacing, ⅞ in.

Boxes—Driving, main and others, cast steel.

Brake, driver—Westinghouse, American-combined, Automatic.

Brake, trailer—Brake pumps, two 8½ in Westinghouse compound; reservoirs, two 22½ x 132 ins.

Engine truck, radial center bearing.

Trailing truck, radial inside bearing.

Piston rod, diameter, 4½ ins.

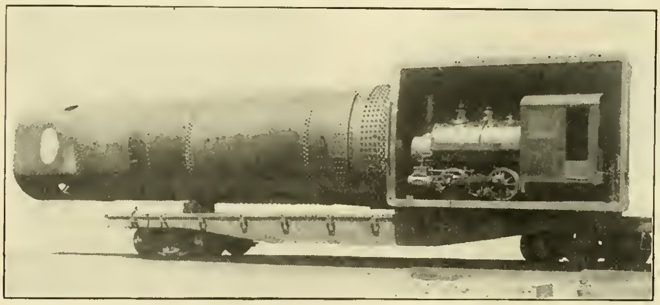
Smoke stack top above rail, 16 ft. 5⅛ ins.

Tender frame, steel channels.

Tank—Style, water bottom; capacity, 12,000 gals.; fuel, 15 tons.

Valves—High pressure cylinders, piston type; low pressure cylinders, double ported slide type.

Wheels—Driving, diameter outside tire, 56 ins.; centers, diameter, 49 ins.; material, main and others, cast steel; engine truck, diameter, 30 ins.; kind, solid forged rolled steel; trailing, diameter, 30 ins.; kind, solid forged rolled steel; tender truck, diameter, 33 ins.; kind, solid forged rolled steel.



BOILER OF MAMMOTH MALLET FOR THE VIRGINIA RAILWAY. DINKEY PLACED INSIDE FIREBOX. CYLINDERS, 6 INS. BY 10 INS.

Firing Extraordinary.

Railroad men as a rule have very vague impressions of how much coal a first-class fireman can throw per hour into a locomotive firebox. We have heard three tons or 6,000 pounds to be the limit, but from remarks made by Mr. C. D. Young, Engineer of Tests of the Pennsylvania Railroad, at the Master Mechanics' Convention, there are firemen in railroad service capable of materially exceeding the three tons.

Mr. Young said: We have some data which I believe is fundamental on the subject of firemen. It has been worked up with that in view, and I believe it would be interesting to the association to know what has been done by firemen, proving at least what can be done, and then from those figures perhaps we might be able to judge what an average man might be expected to do.

Last summer and last fall some capacity tests were run between Ft. Wayne and Valparaiso, a distance of 105 miles, the idea being to determine just how many cars could be hauled on a given schedule speed. Everything was in good shape for the experimental work. The road foreman recommended a man who has broken all records in handling fuel on a locomotive. He had fired for three hours at speeds greater than 60 miles an hour, an average of 8,400 pounds of coal per hour. Not only did he do that, but he would go back and do it again. His work was done with a No. 5 shovel. Had he been given a larger shovel, I believe he could have exceeded those figures. We have had men on our locomotive test

plant fire as high as 9,700 pounds of coal per hour.

Now these are maximum figures. I believe you will agree with me that we should not expect much more. We know time and again men who are firing 3,000 pounds of coal per hour, for a six or eight-hour run on the road, and they are doing all we can reasonably expect for a single fireman.

Land of Great Chemists.

Sweden is a land in which chemistry has playeed an important role from a comparatively early date. Scheele and Berzelius were among the most noted pioneers in the formative period of the science, and no less than twenty of the known chemical elements have been discovered by Swedes. The kingdom owes to three factors its past and present position in technical chemistry. The first is a fairly abundant and diversified mineral wealth. Swedish iron and copper once dominated the world's markets While no longer leading in quantity, Sweden still occupies a foremost position with regard to the quality of its metal products, and the high technical standard of its mining and metallurgical equipment.

Gold in Wyoming Coal.

An interesting feature about the coal mined at Cambria, Wyo., is that it is claimed to be gold-bearing, says a Consular report. Some of the coal has contained as much as $2 per ton in gold, and the coal was sold for only $1.50 per ton. When coke made at Cambria was selling for $3.50 per ton, samples were taken from 31 cars during a period of three weeks and assayed. The samples showed an average of $2.46 per ton in gold and $0.28 in silver. The explanation offered for the presence of gold in this coal is that the sands which submerged the old peat bog and now form the roof of the coal bed were derived in part from gold-bearing alluvium. While the sand was being deposited the gold worked down into the underlying bog and is now found in the coal.

New Quarters for H. W. Johns-Manville Company in Canada.

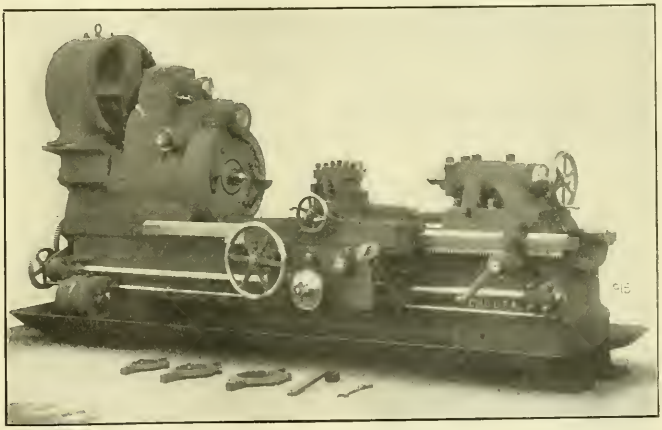
The Winnipeg branch of the H. W. Johns-Manville Company, owing to their fast increasing business in asbestos, magnesia and electrical supplies, found it necessary to move into new quarters at No. 92 Arthur street, Winnipeg, last month. By reason of this move, a much larger and more complete stock of goods will be carried on hand than heretofore, and a larger force will be employed to look after the company's interests.

New and Powerful Heavy Forge Lathe

A new and powerful forge lathe has been introduced by the Lodge & Shipley Tool Company, Cincinnati, Ohio. It is designed for rough turning shafting at the rate of not to exceed 140 ft. per minute on 3 ins. diameter, and at the rate of not less than 61 ft. per minute on a 15-in. diameter. The actual swing over the rest is 15 ins., and the swing over the bed itself is about 30½ ins. The arrangement of speeds is such that the tool is not adapted for large diameters, but only those diameters which will swing over the carriage. The illustration shows this machine with a 12-in. bed, and it will take between centers about 5 ft.

The headstock as shown is designed to receive a 30 h. p. direct current variable speed motor, having a speed ratio of from 400 to 1,200, but any type of motor may be applied and also greater horse power up to 40. There are two gear ratios which, with the motor ratio of 3 to 1 give speeds from 15.6 r. p. m. to 173 r. p. m. The first gear ratio is 6.9 and the second gear ratio is 25.5. Any ratio of gearing may be provided to accommodate motors of higher speeds or to give the driving spindle any desired slower speed. The reducing of the spindle speed will of course increase the gear ratio.

The driving gears are of steel and are hardened and heat-treated. The machine is provided with a compensating face plate drive. The diameter of face plates is 22 ins., and is made of steel. The driving shafts within the headstock are supported on both sides of the gears, thus eliminating all overhang. Pumped oil circulation is provided for all of the driving gears; also all of the journals. The spindle is solid and runs against a solid hardened steel plug at its back end to oppose the great thrust of the spindle. The tailstock has long bearing on the bed, and a locking pawl engages a rack cast inside the bed. The screw for adjusting the tailstock arbor is of large diameter, and the total bearing surfaces of the tailstock on the bed is 120 sq. ins. All spun gears are steel, and all bearings are bronze bushed. The carriage is very long and thick. The bed is very wide at the top and unusually deep. It has a heavy steel oil pan the entire length. The shipping weight of the machine with 30 horsepower motor is about 20,000 lbs.



LODGE AND SHIPLEY'S NEW TYPE OF FORGE LATHE.

Collins Flange Lubricator.

The Delaware, Lackawanna & Western in a recent order for 22 locomotives to be built by the American Locomotive Company, have specified that the Collins Wheel Flange Lubricator be attached to all of them.

To Prolong Human Life.

There is considerable discussion among scientists in France, says the New York *Tribune* in regard to the announcement by Professor Metchnikoff, of the Pasteur Institute, that he is studying the effectiveness of a microbe called "glycobacter" as a preventive of the effects of age.

Professor Armand Gautier, who is a member of the Academy of Sciences, as well as the Academy of Medicine, and Professor Berillon, while admitting interest in Professor Metchnikoff's study, are inclined to doubt its practicability.

Professor Metchnikoff says he has found a beneficent microbe in the intestines of a dog, which, if implanted in the intestines of man, would probably generate sufficient sugar to destroy the human intestinal microbes which are responsible for the maladies of old age.

Items of Personal Interest

Mr. E. H. Hinkens has been made general foreman of the Baltimore & Ohio shops at Glenwood, Pa.

Mr. A. D. Rogers has been made federal district boiler inspector at Kansas City, Mo., vice Mr. T. W. Anderson, deceased.

Mr. E. P. Hughes has been appointed traveling engineer of the Reid Newfoundland Company, with headquarters at St. Johns, N. F.

Mr. J. M. McMurry has been made master mechanic of the Santa Fe at Albuquerque, N. M., vice Mr. L. A. Matimore, resigned.

Mr. James McDonough, formerly master mechanic of the Sonta Fe at Newton, Kan., has been transferred to Shoptan, Ia., on the same road.

Mr. M. J. Drury, mechanical superintendent of the Santa Fe at La Junta, Colo., has been appointed superintendent of shops at Topeka, Kan., vice Mr. John Purcell, promoted.

Mr. Thos. Zinkens has resigned as general foreman of the Big Four at Delaware, O., to accept a similar position with the Cincinnati, Hamilton & Dayton at Indianapolis, Ind.

Mr. John Purcell, superintendent of the Santa Fe shops at Topeka, Kan., has been made assistant to the vice-president, and will handle mechanical department matters, office at Chicago.

C. E. FULLER,
President, M. C. B. Ass'n.

Mr. Charles A. Gill, formerly master mechanic of the Baltimore & Ohio Southwestern at Washington, Ind., has been transferred to Cincinnati, Ohio, in place of Mr. W. G. Rose, also transferred.

Mr. J. F. MacEnulty has been appointed general sales manager of the Pressed Steel Car Company and of the Western Steel Car and Foundry Company, with offices at 24 Broad street, New York.

Mr. H. Honaker, master mechanic of the Frisco Lines at Birmingham, Ala., has been transferred to Fort Scott, Kan., Mr. B. A. Beland, master mechanic at Fort Scott, succeeds Mr. Honaker at Birmingham.

Mr. Bert Peach has been made machine shop foreman of the Santa Fe at Winslow, Ariz. Mr. Jeff Roberts has been made road foreman of engines, vice Mr. H. E. Pendleton, assigned to other duties.

Mr. C. W. Anderson, formerly roundhouse foreman at the Southern railway shops at Selma, Ala., has been transferred to the larger and more important position of roundhouse foreman of the same road at Knoxville, Tenn.

Mr. E. H. Webb, formerly master mechanic of the Michigan Central shops at Michigan City, Mich., has been transferred to St. Thomas, Ont., to take the place made vacant by the promotion of Mr. W. H. Flynn.

Mr. Robert W. Rogers has been appointed practical and technical instructor of apprentices at the Erie shops, Port Jervis, N. Y. Mr. Rogers was formerly assistant engineer of tests at the Erie shops, Meadville, Pa.

Mr. A. F. Aley has been made foreman of the Rock Island shops at Haileyville, Okla., vice Mr. F. Cain, transferred to Sayre, to succeed him. Mr. G. H. Weeks has been made foreman at McAlester, Okla., vice Mr. E. W. Martin, promoted.

Mr. M. C. M. Hatch, engineer of tests of the New York, New Haven & Hartford, the Boston & Maine, and the Central of New England, has been appointed superintendent of fuel service of the Delaware, Lackawanna & Western, with office at Scranton, Pa.

Mr. H. L. Turton has been made division foreman of the Santa Fe at Las Vegas, N. M., vice Mr. T. H. Ogden, resigned to go in other business. Mr. J. H. Suhl has been made roundhouse foreman and Mr. Thos. Sissons assistant roundhouse foreman at that point.

Mr. J. C. Morrison, road foreman of the Chicago, Burlington & Quincy at Lincoln, Neb., has been appointed master mechanic of the Omaha division, with office at Omaha, Neb., in place of Mr. A. N. Willsie, who has been placed in charge of the company's fuel committee at Chicago, Ill,

D. F. CRAWFORD,
President, M. M. Ass'n.

Mr. Edmund D. Bronner, formerly superintendent of motive power of the Michigan Central, has been appointed general manager, and Mr. W. H. Flynn, master mechanic at St. Thomas, Ont., has been appointed superintendent of motive power, with Mr. P. J. Burns as assistant.

Mr. D. G. Cunningham, formerly general foreman of the Norfolk & Western at Williamson, W. Va., has been appointed superintendent of shops of the Denver & Rio Grande, with office at Salt Lake City, Utah, and Mr. W. O. Williams has been promoted from machine shop foreman to general foreman at the same place.

Mr. H. Wanamaker, superintendent of shops of the New York Central at Depew, N. Y., has been appointed superintendent of shops at West Albany, N. Y., vice Mr. L. H. Raymond, resigned. Mr. J. G. Parsons succeeds Mr. Wanamaker at Depew, and Mr. B. F. Shone has been appointed general foreman of the Depew shops.

Mr. William L. Derr, who has been steam railroad inspector for the Public Service Commission, second district, since

June, 1909, has resigned to become superintendent of one of the principal divisions of the Chicago Great Western Railroad. He will have charge of the division for about 400 miles, running from Omaha to Olewin, Iowa.

Mr. H. G. Rose, formerly master mechanic of the Cincinnati, Hamilton and Dayton at Ivorydale, Ind., has been transferred to the Moorfield Shops, Indianapolis, Ind. Mr. C. A. Gibb has been appointed master mechanic at Ivorydale, with jurisdiction over the Toledo division, and Mr. H. C. Caswell, formerly foreman at Gest St. has resigned to take a position with the Pere Marquette.

Mr. John G. Platt has been appointed sales manager of the Hunt-Spiller Manufacturing Corporation, with offices at 383 Dorchester avenue, Boston, Mass. Mr. Platt has occupied the position of mechanical representative for five years with the corporation, but the large increase in their business necessitates a sales manager and Mr. Platt's promotion is a fitting recognition of his ability and services.

The Watson-Stillman Company, 50 Church street, New York, announce the following officers elected last month. Pres., Mr. E. A. Stillman; vice-president and secretary, Mr. A. F. Stillman; treasurer, Mr. J. P. Bird; chief engineer, Mr. Carl Wigtel; superintendent, Mr. Frank Lary. A new branch office is being opened in Philadelphia and shop facilities are being improved to meet increasing business.

P. H. DONOVAN.

Mr. Samuel G. Thomson has been appointed superintendent of motive power of the Philadelphia & Reading, with offices at Philadelphia. Mr. Thomson graduated from Princeton University in 1898, and entered the railway service in the same year as a special apprentice in the Altoona shops of the Pennsylvania. He was appointed inspector of car shops there in 1903, and general foreman of the shops at Bedford, Pa., in 1904, and latterly master mechanic at Harrisburg, Pa.

The following is the list of officers chosen by the Master Boiler Makers' Association for the ensuing year: President, Mr. M. O'Connor, Chicago & Northwestern, Missouri Valley, Ia.; vice-presidents, Mr. T. W. Lowe, Canadian Pacific, Winnipeg, Man.; Mr. J. T. Johnston, Santa Fe Ry., Los Angeles, Cal.; Mr. Andrew Green, Big Four, Beech Grove, Ind.; Mr. D. A. Lucas, Burlington Ry., Havelock, Neb.; Mr. John Tate, Pennsylvania Railroad, Altoona, Pa.; secretary, Mr. H. D. Vought, 95 Liberty street, New York; treasurer, Mr. Frank Gray, Chicago & Alton, Bloomington, Ill. Three members of the executive board, Mr. B. F. Sawer, Mr. W. H. Laughridge and Mr. A. N. Lucas. Mr. John A. Doarnberger, Norfolk & Western, Roanoke, Va., was chosen chairman of the board. The city of Chicago was chosen as place of meeting in 1913, date of same to be announced later.

New Officers for M. C. B. Association.

The following-named gentlemen were elected officers of the Master Car Builders' Association for the fiscal year beginning June 14, 1912: President, Mr. Charles E. Fuller, superintendent of motive power, Union Pacific, Omaha, Neb.; first vice-president, Mr. M. K. Barnum, general superintendent of motive power, Illinois Central, Chicago, Ill.; second vice-president, Mr. D. F. Crawford, superintendent of motive power, Pennsylvania Lines, Pittsburgh, Pa.; third vice-president, Mr. D. R. MacBain, superintendent of motive power, Lake Shore & Michigan Southern, Cleveland, Ohio; treasurer, Mr. John S. Lentz, master car builder, Lehigh Valley, South Bethlehem, Pa.; secretary, Mr. Jos. W. Taylor, Old Colony building, Chicago, Ill.

Executive committee: Mr. R. E. Smith, general superintendent of motive power, Atlantic Coast Line, Wilmington, N. C.; Mr. C. E. Chambers, superintendent of motive power, Central of New Jersey, Jersey City, N. J.; Mr. Henry La Rue, master car builder, Chicago, Rock Island & Pacific, Chicago, Ill. The other members of the executive commitee will be added at the meeting of the executive to be held during the present month.

New Officers of the M. M. Association.

The following-named gentlemen were elected officers of the American Railway Master Mechanics' Association for the fiscal year beginning June 19, 1912: President, Mr. D. F. Crawford, superintendent of motive power, Pennsylvania Lines, Pittsburgh, Pa.; first vice-president, Mr. T. Rumney, assistant to the vice-president, Chicago, Rock Island & Pacific, Chicago, Ill.; second vice-president, Mr. D. R. MacBain, superintendent of motive power, Lake Shore & Michigan Southern, Cleveland, Ohio; third vice-president, F. F. Gaines, superintendent of motive power, Central of Georgia, Savannah, Ga.; treasurer, Dr. Angus Sinclair, Editor-in-Chief, RAILWAY AND LOCOMOTIVE ENGINEERING; secretary, Mr. Jos. W. Taylor, 390 Old Colony building, Chicago, Ill.

S. W. DUDLEY.

Executive committee: Mr. C. A. Seley, mechanical engineer, Chicago, Rock Island & Pacific, Chicago, Ill.; Mr. J. F. Walsh, general superintendent of motive power, Chesapeake & Oho, Richmond, Va.; Mr. G. W. Pratt, assistant superintendent of motive power, Chicago & Northwestern, Chicago, Ill.; Mr. G. W. Wildin, mechanical superintendent, New York, New Haven & Hartford, New Haven, Conn.; Mr. Wm. Schlafge, general superintendent of motive power, Erie, New York, and Mr. C. F. Giles, superintendent of motive power, Louisville & Nashville, Louisville, Ky.

Messrs. S. W. Dudley and P. H. Donovan.

Through increased volumes of business competition, and a desire to excel, American manufacture has become a science and in many instances an art, and in the design, development and disposal of products, the directors of large enterprises employ the most expert and efficient men that money can procure.

In many instances managers or heads of departments succeed in their chosen career through their own genius and individual effort and often they succeed because they have surrounded themselves with experts in every branch of

the work engaged in, but in the case of Mr. Turner, of the Westinghouse Air Brake Company, and his assistants, Mr. S. W. Dudley and Mr. P. H. Donovan, we have both the individual effort and the expert assistance.

As an example of what can be accomplished by trained men working in harmony, we would mention a competitive air brake trial conducted at Albany, N. Y., some years ago.

On Thursday of that particular week it was found that the brake in use, which was, by the way, the best obtainable, could not stop the trains from high rates of speed in desirable distances, but Mr. Turner was able to see what was needed to shorten the stop to the required distance, but it also involved the manufacture of a new type of triple valve. That evening a drawing of the triple valve was made on the board at Wilmerding from Mr. Turner's instructions over the long distance telephone.

Friday the valves were cast, machined, bushed and fitted, Saturday morning they were taken aboard a passenger train in suit cases and during Sunday and Sunday night they were installed on the test train.

Monday morning they went into service and cut off 350 ft. distance from the best previous stop, which is a brief history of the design of the present type L triple valve.

Such work could only be done in the present age and by a practically perfect organization, and we believe that in the employment of men of the mental calibre of Messrs. Dudley and Donovan the Westinghouse Air Brake Company have fort-i fied themselves against any emergency and have insured for themselves efficient and up-to-date air brake equipments for many years to come.

It is a pleasure to be able to place before our readers a likeness of two of the brightest young air brake experts of today, who also have the generous spirit and unaffected manner so noticeable among the members of the Westinghouse organization.

Obituary.

WILLIAM BUTLER DUNCAN.

Much regret is being expressed at the death of Mr. William Butler Duncan, of New York, who was for nearly forty years identified with the Mobile & Ohio Railroad Company either as president or chairman of the board of directors. He was greatly esteemed among the leading railway men and by all who had the honor of his acquaintance. He was a wise and good man.

Tool Foremen's Association.

The American Railway Tool Foremen's Association will hold their annual convention at the Hotel Sherman, Chicago, on July 9, 10 and 11. The association is one which should meet with the warmest encouragement from the higher motive power officials, as much of the growing efficiency of the mechanical department is due in no small degree to the high intelligence of the toolroom foremen. The meeting promises to be of marked interest and of increased attendance.

The Scot as a Railroader.

James Watt, the celebrated improver of the steam engine, entertained a very low opinion of the mechanical ability of Scotsmen, but he was prejudiced without just cause. The impression was spread that Highlanders had no skill as artizans, although, in truth, their smiths were the best sword makers in the British Isles.

The story is told that Archibald, the blacksmith of the McPherson clan, committed a crime that caused the sheriff of Invernesshire to cause his arrest and intended hanging the sword maker. When Cluny McPherson heard of the outrage he went to the sheriff and offered to let him hang two weavers to hang in place of the one smith, showing the estimation in which the smith was held.

Scotsmen have taken very kindly to railway life in America. In an address delivered before a Scotland society Dr. Angus Sinclair said:

"The operative office of our railways number close on 21,000. Scot's names are fairly represented on this list, with 744 Macs, 81 Anderson, 68 Wilson, 60 Thompson, 52 Campbell, 41 Stuart and Stewarts, 39 Scott, 39 Walker, 37 Reed and Reid, 37 Mitchell, 31 Morrison, 29 Kennedy, 28 Ross, 26 Murray, 26 Turner, 25 Hamilton, 25 Ford, 22 Johnston, 22 Cook, 21 Gordon, 19 Simpson, 18 Robertson, 17 Crawford, 17 Burns, 17 Fraser, 16 Henderson, 16 Maxwell, 14 Cameron, 13 Buchanan, 13 Chambers, 13 Elliott, 12 Lindsay, 12 Leonard, 10 Grant, 5 Sinclair, 1 Carnegie, a total of 1,666.

How Millionaires Are Made.

Andrew Carnegie, who had been elected Lord Rector of Aberdeen University, delivered his rectoral address on June 6 in which the following sentiments are expressed:

"My experience with young men pursuing their careers soon led me to the conclusion that the use of liquor was the rock upon which more were hopelessly wrecked than any other. Such has been our experience; striking this rock means almost certain ruin. As a rule, nothing can be done with the drunkard. Exceptions there may be, but these are rare, indeed. The most welcome news that the true Scot abroad has heard recently is that his native land is becoming less and less open to the charge that of English-speaking lands she is in this respect the most degraded of all. The rule of the young men of Scotland, 'Touch not, taste not, handle not,' I hope is becoming more popular each succeeding year. One rule I have often suggested to youth: 'Remain teetotallers until you have become millionaires.' Certain am I that this would greatly accelerate their victory.

"In the Republic, and I believe here also, if there were two candidates for promotion equally matched and one smoked and the other did not, the latter would be preferred as less extravagant and more sensible. Certainly the less odorous candidate would always win with me. As between a strictly temperate youth and a drinker of liquor there could be no contest. The moderate drinker would not be considered, the risk of his becoming an inordinate one being much too great. Believe me, the young man who drinks or smokes voluntarily handicaps himself in the race of life. That he does either or both shows that he lacks something; he does not know how best to train himself for the race. The coming man leaves nothing to chance, nor, mark you, does he spend his slender means foolishly; certainly not if he is to prove the coming millionaire. You find him stripped for the race, carrying no superfluous weight in the day of trial. 'Trifles these,' no doubt some of you may be thinking, especially smoking, but, remember, we have seen it is almost impossible to know what are trifles. In the race of life a foot ahead wins the race; a pin turns the scale. A very small difference, indeed, creates the victor. The poor young man entering upon his career which has either service, fame or fortune for its aim, should remember that the horse wins the race only because it arrives a neck ahead of competitors. The 'little more' does it. It is duty done and the 'little more' that always tells."

Drunk by Accident.

A fierce old colonel one day called his negro coachman to him. "You were drunk yesterday!" he roared. "What do you mean by such a performance?"

" 'Twas an accident, sah, pon mah word."

"An accident?"

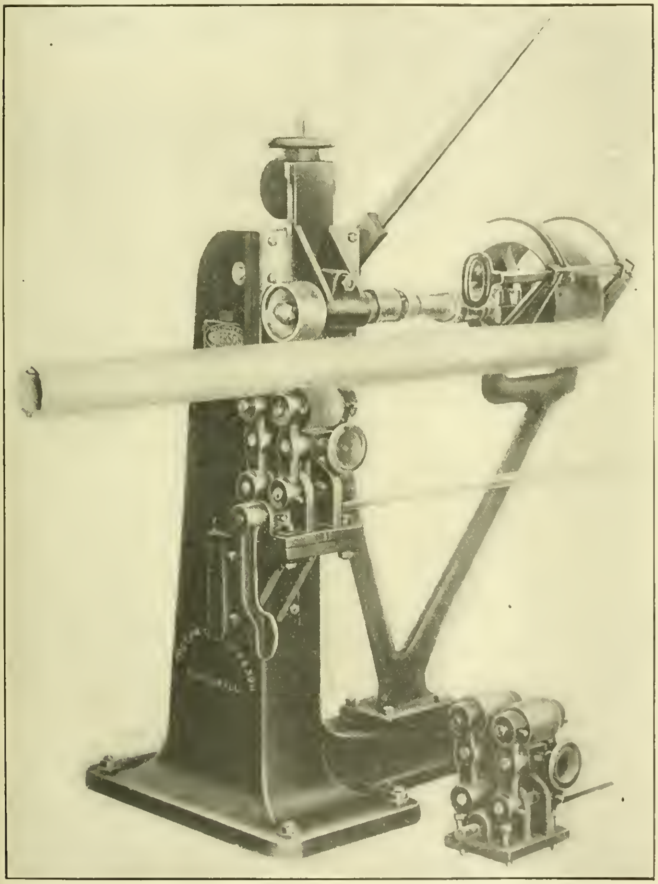
"Yes sah. In de mornin' I gets a jimmyjohn ob rum fer t' keep de rheumatiz from mah ole woman, an', Marse John, I slips on de ice an bust de jimmyjohn, an' de rum makes little puddles in de road. Den, sah, I jes' gets down an' laps some up. Dat's how it cum, Marse John."

"You black rascal! How much did you drink?"

"Well, Marse John, sah," answered old Ned, with a twinkle in his eye, "I s'pose I mus' er saved more en a quart."

New Matthews Tube Cleaning Attachment

A new tube cleaner has just been placed upon the market by the well-known manufacturers, Joseph T. Ryerson & Son. It is known as the new Matthews tube-cleaning attachment and is specially designed to be used in connection with their well-known tube-cutting machine. This combination for tube cleaning and tube cutting gives the shop two complete machines for scarcely more than the price of one and which only requires the working space of one. One passage through the cleaning burrs finishes the cleaning, the tubes traveling about ten feet per minute. The scale is thoroughly scoured off the tubes without the slightest possibility of damage due to denting or chipping.



THE MATTHEWS NEW TUBE CLEANER.

The essential elements are the friction wheel and the adjustable twin roller cleaning burrs, which are built up of hardened serrated steel discs. These twin roller cleaning burrs are assembled in a unit which is readily interchangeable with the roller tube support employed when the machine is used for cutting tubes. Hence, only two changes are required to change the cutting machine over to a cleaning machine: (1) replace the cutting disc with the friction wheel, and (2) replace the tube support with the cleaning burrs.

When used for cleaning the longitudinal travel of the tubes is effected by adjusted roller support slightly out of square—the direction of travel and the rate of speed being determined by angle of divergence. When equipped for cutting tubes this machine is designed to meet the requirements of the general run of shop work, and handles tubes from ⅜ inch to six inches in diameter. The design is simple, substantial and compact. There is practically nothing to become worn or to get out of order. The main spindle bearing is turned from the best quality of bronze and the driving shaft bearing is lined with high-grade Glyco Babbitt metal.

A three-fold economy is claimed for this machine: (1) it reduces the cost of cleaning to about 1-10 of the hand method, (2) it saves the labor cost of carrying the tubes between machines, and (3) it is the ideal tool for the moderate sized shop, as the one machine will do all the work which at best would require two separate machines, thereby saving the expense and floor space of a second machine.

Concerning Flues.

At a meeting of the mechanical officials of the Erie Railroad, the subject of iron versus steel tubes was thoroughly discussed, and it was decided that the mechanical engineer draw up specifications changing our clossification and going from iron to steel tubes. This change will result in a saving of approximately $7,110 per year.

After the matter of beading had been thoroughly discussed and various opinions given, it was unanimously decided that we discontinue beading flues on front sheet excepting the superheater tubes. This to be embodied in our standard practice card on flue setting. Mr. Cozad to see that piecework prices are modified accordingly.

The subject of prossering flues every thirty days was very thoroughly discussed. Our general boilermaker foreman on the east end of the system is of the opinion that this is not necessary, but that flues should be prossered only as required after careful inspection. It was therefore decided to select the Buffalo division as a place to make a test of this work, and for a period of the next six months the flues on this division are to be prossered only as required. The mechanical superintendent and general foreman boilermaker are to make a 40 per cent. reduction in the number of hot workers in the roundhouses on this division. At the expiration of six months we are to compare the flue failures with the corresponding period of last year.

The mechanical engineer to check up C-6 and G-8 boilers and advise whether it is not practicable to leave out some of the bottom flues in these engines, as they are entirely too close to the grates.

Standard practice card No. 108, which covers flue setting, to be modified, as it is decided that no more flues will be beaded in front end.

Standard practice card No. 108-B: Insert paragraph six, "It is required that flues be prossered to flue sheet once every thirty days."

Discrediting College Life.

Our old friend Richard Crane said some very disparaging things about college education, but his criticisms were mild compared with criticisms made by Mr. Owen Johnson in *McClure's* and reproduced with comments by the *Literary Digest.*

Johnson, under the name of Brockhurst, is a sort of iconoclast who is opposed to ignorant humbug, and asks no end of embarrasing questions that hit the point every time because the questioner is a graduate of Yale and knows whereof he speaks.

Brockhurst turns on Swazy with the query: What do you know about the Barbizon school, and the logical reasons for the revolt of the Impressionists? The answer was a blank, and Brocky proceeded to rub it in.

"I'm not contending you should have a detailed knowledge of the world in your eager studious minds. I am saying that you haven't the slightest general information. I'll make my question fair.

"First, music. I won't ask you the tendencies and theories of the modern schools—you won't know that such a thing as a theory in music exists. You know the opera of 'Carmen'—good old Toreador song! Do you know the name of the composer? One hand—Bob Story. Do you know the history of its reception? Do you know the sources of it? Do you know what Bach's influence was in the development of music? Did you ever hear of Leoncavallo, Verdi, or that there is such a thing as a Russian composer? Absolute silence. You have a hazy knowledge of Wagner, and you know that Chopin wrote a funeral march. That is your foothold in music; there you balance, surrounded by howling waters of ignorance.

"Take up architecture. Do you know who built the Vatican? Do you know the great buildings of the world, or a single thing about Greek, Roman, and Renaissance architecture? Do you know what the modern French movement is based upon? Nothing.

"Take up religion. Do you know anything about Confucius, Shintoism, or Swedenborg, beyond the names? . . . Do you know the history of the external symbols of the Christian religion, and what is historically new? Darkness denser and denser!

"Take literature. You have excavated a certain amount of Shakespeare, and grubbed among Elizabethans, and curst Spencer. Who has read Taine's 'History of English Literature,' or knows, in fact, who Taine is? . . . Do you know anything about Goethe as a critic, or the influence of Poe upon French literature? What do you know? I'll tell you. You know 'Les Misérables' and 'The Three Musketeers' in French literature. You know that Goethe wrote 'Faust.' You're beginning to know Ibsen as a name, and one or two may have read Tolstoy, and all know that he's a very old man with a long white beard, who lives among his peasants, has some queer ideas, and has started to die three or four times. The papers have told you that."

The amazed silences that followed "*Brocky's*" flow of questions pertaining to these mysterious fields of learning proved up to the hilt that no one but he knew anything. Then he turns a broadside of accusation upon them:

"You don't know the big men in music; you don't know the pioneers and the leaders even in any art; you don't know the great literatures of the world, and what they represent; you don't know how other races are working out their social destinies; you've never even stopped to examine yourselves, to analyze your own society, to see the difference between a civilization founded on the unit of the individual, and a civilization, like the Latin, on the indestructible advance of the family. You have no general knowledge, no intellectual interests; you haven't even opinions; and at the end of four years of *education* you will march up and be handed a degree—a Bachelor of Arts. Magnificent! And we Americans have a sense of humor. Do you wonder why I repeat that our colleges are splendidly organized institutions for the prevention of learning? No, sir; we are business colleges, and the business of our machines is to stamp out so many business men a year, running at full speed and in competition with the lastest devices in Cambridge and Princeton!"

FROM THE ENGLISH STANDPOINT.

Sir Ray Lankester, a prominent Englishman, said recently: "One of the old English universities might be described as 'a place—one of them is Oxford, the most beautiful place in the world—where young men go to live in colleges for six months in the year in order to have a good time, learn a little, and take a degree, which is regarded as a certificate of gentility and entitles them to vote for two members of parliament and to veto all improvement in the methods and organization of the university.' "

Study of Valve Gearing.

Every ambitious railway mechanic wishes to know particulars about valve motion, how it operates in distribution of steam to the cylinders, and how defects can be remedied. We know for a fact that when an article appears in any paper describing valve setting or anything else relating to valve movement, it is carefully cut out by many persons and filed away for future reference. That is good practice, and displays live interest in an important subject; but it is a better plan to obtain a book that gives full, clear information about valve mechanism and valve setting. We were moved to this line of thought through receiving from a shop foreman a request for information concerning the setting of Baker-Pilloid valve gear. The matter is fully explained in "The Valve Setters' Guide," a treatise on the construction and adjustment of the principal valve gearings used on American locomotives, by James Kennedy. That valuable book is for sale in this office for the ridiculously small sum of 50 cents. To one needing the clear information given in this book, it would be cheap at ten times the sum for which it is sold. The preface of the book gives this useful hint:

"As the valve gearing is the most intricate part of the reversible steam engine, so the study of valve gearing is calculated to develop the faculty of giving thoughtful attention to the details of all forms of involved mechanism."

Diary of a Roundhouse Foreman.

The Norman W. Henley Publishing Company, New York, has just issued a book of 158 pages, with the above title. The author, Mr. T. S. Reilly, has had considerable experience as a railway man, and much of the book is taken up in the solution of the knotty problems that come into the everyday life of a roundhouse foreman. The author has a fine sense of humor, and doubtless many of the stories are, in reality, incidents in which Mr. Reilly himself figured, and enabled him to gain a close vision of the men who live and move and have their strenuous being in roundhouses. The book is at once entertaining and instructive, and while the author takes care that the reader never loses sight of him for an instant, the book will well repay a perusal. Cloth binding. Price, one dollar.

The Worry Method.

After taking anti-fat treatment for a week, an obese person received a bill.

"But, doctor," he protested, "I haven't lost an ounce. The bill is too big."

"The bill," the doctor informed him, curtly, "is part of the treatment."—Philadelphia Ledger.

Not a Bad Idea.

"There's a lot of talk in the papers," said Mr. Dumley, "about the 'necessity of uniform divorce laws.' Wonder what they mean by that?"

"Probably," suggested Mrs. Dumley, "it's to compel divorced people to wear a uniform so other folks can recognize 'em."

Railroad Notes

The Monon has ordered 3 Pacific type locomotives and 16 Mikado engines.

The Wabash has contracted for 36,000 tons of rails to be used in second track construction between Chicago and St. Louis.

Orders have been placed by the Harriman lines for 55 Mikado engines, 15 Mallet engines, 20 switch engines, 15 Pacific type engines.

The Erie has ordered five Pacific type locomotives from the Lima Locomotive Works, Lima, Ohio. The cylinders will be 27 ins. by 28 ins.

Federal boiler inspectors who investigated the Southern Pacific explosion at San Antonio, Tex., on March 18, report that the explosion "was due to excessive steam caused by an inexperienced employee tightening the screws of the safety valve."

The Chicago & Eastern Illinois has ordered 25 Mikado locomotives from the American Locomotive Company. These will be equipped with Schmidt superheaters. The cylinders will be 28 ins. by 30 ins. The total weight of engine and tender will be 471,000 lbs.

The Rutland Railroad is to become the property of the New York, New Haven & Hartford. Last month the Public Service Commission of New York State gave consent to the purchase by the above company of 47,041 shares from the New York Central Railway.

The St. Louis & San Francisco has ordered 40 simple consolidation locomotives from the American Locomotive Company. These will be equipped with Schmidt superheaters. The cylinders will be 26 ins. by 30 ins., and engine and tender will weigh 396,000 lbs.

The Boston & Albany is reported to be in the market soon for 150 locomotives and the Chesapeake & Ohio for 50 locomotives. The Seaboard Air Line ordered 26 locomotives late in May. The Burlington ordered 50 Mikado locomotives in May. The New Haven road ordered in May 15 steam and 24 electric locomotives.

The Reading Railway Company, at its car shops at Reading, Pa., is about ready to begin work on a new type of engine, to be used on the Frackville branch. It will be five feet longer than those now in use, and have greater traction power. Because of the heavy grade the heaviest kind of engines have been required to shove the empty cars up the incline.

The Baltimore & Ohio Railroad has placed ten new all-steel postal cars in service on through express trains. Some of them will be used in the Philadelphia, Washington and New York service. The steel postal cars are seventy feet long and are equipped with anti-telescoping devices. The interior finish is of fireproof agasote, an English composition said to be more durable than wood.

One of the latest railroads to join the ranks of those using the telephone for the handling and control of trains is the Pittsburgh, & Lake Erie. With this end in view the officials of the road have recently placed an order with the Western Electric Company, the manufacturer of the telephone apparatus used by ninety per cent. of the railroads in the United States, for the material necessary to equip their line.

W. C. Nixon, vice-president of the Frisco, states that 25,000 tons of new 90-lb. rail have been ordered and will be laid on the Frisco during this year. The first consignment will be received in July and this will replace the 75 and 85-lb. rail at various points between St. Louis and Springfield, Springfield and Memphis, Monett and Paris, Kansas City and Springfield, and on the lines extending south and southwest from Sapulpa, Okla., and Monett. New rail is now being laid between Oklahoma and Sapulpa, Okla.

In the last ten years more than 4,500,000 trees—4,615,227 to be exact—have been planted by the Pennsylvania. This fact is brought out in a report which shows on what extensive lines the Pennsylvania System has undertaken the conservation of the natural resources of the territory traversed by its lines. Last year 515,703 trees were transferred from the company's nursery at Morrisville, Pa., to permanent places on railroad property.

At the nursery the Pennsylvania has in operation thirty-six acres which are kept up to practically maximum production.

Suspensions from next July 8 to November 5 of the Transcontinental Freight Bureau's eastbound tariff was announced today by the Interstate Commission. The tariff named advanced rates for the transportation of hop in bales from North Pacific Coast terminals and intermediate stations to destinations in the State of New York and other points.

The present rate is $1.50 per 100 pounds carloads, and $2 per 100 pounds less than carloads. The advanced rates which have been suspended are $1.75 per 100 pounds carloads, and $2.25 per 100 pounds less than carloads.

Railway Exhibits at Atlantic City, N. J., and Other Products

The American Balance Valve Company, of Jersey Shore, Pa., exhibited a model of the Wilson-Stevens valve gear, and also a Walschaerts model, as well as American semi-plug piston valves for both saturated and superheated engines. Anything that has to do with superheaters these times is always of interest.

The American Brake Shoe & Foundry Company of Mahwah, N. J., had an attractive exhibit of brake shoes, including the important perfecto type of reinforced driver shoes, and other specialties of a similar nature.

Speaking of brake shoes, reminds us of other appliances near the ground, and in this connection, the Alexander car replacer is brought to our mind. This is a very excellent pressed steel frog which is doing great things, and which is bound to become more and more popular.

The Ashton Valve Company is well known for its high-class gauges and pop valves, and has brought out something new in the way of a hydraulic recording instrument to be used in connection with a wheel press. By means of this instrument, it is possible to tell, as the wheel moves on to the axle, whether or not it is taking hold at all points, or whether there is an occasional low spot or "jump."

When we speak of any appliance or instrument which requires pipe tools to connect, the name of the Armstrong Manufacturing Company, of Bridgeport, Conn., naturally occurs to us. The pipe tools and other appliances made by this concern are too well known to need any comment.

And then sometimes, even with good pipe tools, there is a burr to be filed off, or, in fact, if there is any filing to be done, what better file is there than the "Black Diamond"? The G. & H. Barnett Company, of Philadelphia, Pa., will tell you all about this.

The S. F. Bowser & Co., of Fort Wayne, Ind., as usual, made a very attractive exhibit. The line of oil filtration and circulating systems, manufactured by this company, evidences the ingenuity of their engineers, as well as their thorough understanding of the needs for these appliances.

The Carborundum Company, of Niagara Falls, N. Y., had an exhibit with their abrasive wheels in actual operation, and their painstaking efforts to show the actual cutting qualities of their product was appreciated by all who visited their booth.

The Collins Metallic Packing Company made a fine display, including not only their regular line of goods, but also the Collins wheel flange lubricator, which is growing in popularity, and is finding favor with railroad men throughout the world. They had a wheel set up with the flange lubricator in place.

The Commonwealth Steel Company, of St. Louis, Mo., had a booth with photographs of interest to those interested in their product, and, as is often said, Commonwealth castings are good castings.

We might also add that the Cleveland City Forge & Iron Company, of Cleveland, Ohio, make good forgings.

The Crosby Steam Gauge & Valve Company, of Boston, Mass., showed their regular line of railway appliances, including gauges and valves, and their two specialties, the Lanza Adjustment for an indicator, and their fluid pressure scale for testing gauges up to 25,000 pounds.

The Detroit Lubricator Company, of Detroit, Mich., displayed their air cylinder lubricator, boiler valves, valve lubricator, Bull's Eye locomotive lubricators, Detroit transfer filler, and other goods of their manufacture. The Detroit Lubricator Company is old and well known, and their goods are always dependable.

Another old and reliable concern is that of Richard Dudgeon, of New York, the pioneer of hydraulic jackdom. His universal hydraulic jack possesses a number of important features, the most important of which is undoubtedly the double connected tandem pump, which gives one the opportunity to use either side in case the other gives out.

We could not do justice to our subject at large, if we did not mention the well-known concern of J. A. Fay & Egan Company, of Cincinnati, Ohio. These people are constantly introducing new and important tools in the line of wood working machinery.

The General Electric Company made a very elaborate display featuring a number of their new specialties, which were studied with a great deal of interest by those present.

The Garlock Packing Company, of Palmyra, N. Y., as usual, showed their good old line of fibrous and metal packings, and also their specialties for various purposes. To the Garlock Company is due a great deal of thanks, for their educational work in the matter of packings.

The Gold Car Heating & Lighting Company, of New York, made a very complete and interesting display covering combination pressure and vapor systems, heat storage system for refrigerator cars, thermostatic temperature regulator, cyclone ventilators, double coil system of hot water circulation, and quick detachable ventilated core electric heaters. The painstaking explanations furnished by those in charge of this exhibit were appreciated.

The Goldschmidt Thermit Company, of New York, displayed their apparatus for welding broken parts, and also illustrated the actual workings of the system by means of moving pictures. The interesting spectacular demonstrations at this booth attracted much attention.

The Gould Coupler Company showed their usual number of interesting devices, among which might be mentioned their improved heavy type "Z" coupler, with new type lock and lock-set and knuckle opener for heavy service, a new form of truck bolster, friction draft gears, new passenger couplers, and their well-known inset lid journal box.

William Jessop & Sons showed Jessop's Ark High Speed Steel, for which they make a well-founded claim for the highest efficiency. By repeated tests of speed, feed and cut, this steel has evidently won fairly the place it holds. The company has records of the performance of Ark steel, and those in attendance gave many valuable hints for economies in this line.

The H. W. Johns-Manville Company, of New York, exhibited a full line of asbestos products, including roofing, packing, locomotove lagging, air brake cylinder expander rings, pipe and boiler coverings, smoke jacks, asbestos wood and fiber conduit.

The Keystone Lubricating Company, of Philadelphia, Pa., have a new driving box, which they showed in a unique and interesting manner, by means of a set of drivers mounted in boxes, the Keystone box on one end, and a box of another make on the other end of the axle. The wheels were revolved by means of a motor and a friction roller. Great things are claimed for this Keystone locomotive journal box, which embodies important features in lubrication. It is claimed that by the use of this box a saving of 80 per cent. in labor will obtain, and in addition to this, a 75 per cent. saving of time the locomotive is out of service; and in lubrication, a saving of 300 to 400 per cent., to say nothing of the increased life of the brasses.

With all the appliances and specialties for locomotive use, we must not overlook the specialties in locomotives themselves. The standard engines, industrial, lagging locomotives and the Shay geared locomotives, manufactured by the Lima Locomotive & Machine Company, Lima, Ohio, deserve more than a passing notice.

The Locomotive Improvement Company, of Clinton, Iowa, presented a full-size print, illustrative of their solid end main rod, as well as models of this and their other specialties.

The Lohmann process for the permanent protection of iron and steel, as put forth by the Lohmann Company, of New York, is awakening much interest.

Another familiar name is that of the National Malleable Castings Company, of Cleveland, Ohio. This year this concern showed not only its old and tried substantial line, but various new contrivances of interest to those in attendance.

The O'Malley-Beare Valve Company, of Chicago, Ill., manufacturers of the multiplate valves, had indeed a very interesting display, which comprises not only a general exhibition of their goods, but also a demonstration of some of the valves in actual use.

The attractive space occupied by the Pressed Steel Car Company, of Pittsburgh, Pa., evidenced in its furnishings, the comfortable security which is reputed to the character of their product.

The Permanent Manufacturers' Exhibit, railway supplies and equipment, which is now in full sway at the Karpen building, in Chicago, were well represented. The exhibit at Chicago is interesting in the extreme, and it is to be easily seen that this will grow in prominence and utility as time goes on, becoming more and more a pronounced feature of publicity for the interests it represents.

The Pilliod Company, of Swanton, Ohio, had a full-sized working model on exhibition, and also their complete engine model, equipped with the Pilliod valve gear, the same as shown heretofore. The point most emphasized by this exhibit this year seems to be that of standardization and perfection of construction.

The diamond steel emery, characterized as a railroad shop necessity, is manufactured by the Pittsburgh Crushed Steel Company, of Pittsburgh, Pa., and many purposes for which this product can be used were evidenced in various ways on the pier.

A talk with a representative of the H. K. Porter Company, of Pittsburgh, Pa., regarding various types of locomotives made by them, was very interesting. The

different locomotives run by steam, compressed air, and gasoline, varies the monotony.

The Pyle National Electric Headlight Company, of Chicago, as usual, made an interesting display, and one which always attracts considerable attention.

The Standard Car Truck Company, of Chicago, had an exhibit on the Reading tracks, two blocks from the pier, in the shape of a flat car design for 100,000 lbs. capacity, the load carried on two main drop steel girder sills of special form. This car is an innovation in its way, and is well worthy of a thorough investigation by railway officials.

The Standard Coupler Company, of New York, had a space on the main floor for the reception of their friends.

The various exhibits of brass specialties, etc., cover considerable territory, and in this connection, it is highly consistent to mention the non-corrosive gauges and engine room appliances, manufactured by the Star Brass Manufacturing Company, of Boston, Mass. An instrument or valve with non-corrosive working parts has undoubted merit.

A great variety of tools was shown for exhibition purposes, and a great many tools were shown inadvertently to be those of the L. S. Starrett Company, of Athol, Mass., which were often seen in the hands of those who were putting them to actual use.

The Storrs Mica Company, of Owego, N. Y., as usual, had an interesting display, showing the various new features in their regular line, as well as specialties not heretofore exhibited.

The Tabor Manufacturing Company, of Philadelphia, Pa., showed their saw plates and saw tooth grinder, in connection with the Newton cut-off machine. Also a standard Taylor-Newbold saw of the external tooth type, operated by the Newton internal machine.

H. B. Underwood & Co., of Philadelphia, Pa., also manufacture some very good tools, indeed, the most prominent of which are a circular planer attachment, portable cylinder boring bar, and a pipe bender, which is unique in its design.

A friend from the Northwest, in speaking of various forms of engines, and mine machinery, mentioned the Vulcan Iron Works, of Wilkes-Barre, Pa., in the highest terms.

Another friend gave us several new pointers on the varied line of tools and supplies manufactured by the Walworth Manufacturing Company, of Boston, Mass.

The Watson-Stillman Company had a display principally devoted to the Chambers throttle valve. In addition to this, this company also showed a few of their standard hydraulic tools, jacks, etc.

A report upon railway appliances, large or small, would not be complete without the mention of the Wm. H. Wood locomotive fire box, manufactured at Media, Pa. The automatic expansion and construction adjustment in this firebox has been so thoroughly explained in times past, that it is needless to go into details. Mr. Wood makes strong claims, which are substantiated by various data.

A number of exhibits were resplendent in polished metal, which would indicate a liberal use of U. S. metal polish.

A number of exhibitors who did not show machinery or tools, had very handsome reception booths, where their representatives received their friends.

In addition to the exhibitors above mentioned, the following were either represented by exhibit or reception booths: The American Arch Company, New York; the American Locomotive Company, New York; American Steel Foundries, Chicago, Ill.; American Vanadium Company, Pittsburgh, Pa.; Baldwin Locomotive Works, Philadelphia, Pa.; Chicago Car Heating Company, Chicago, Ill.; Commercial Acetylene Company, New York; Dearborn Drug & Chemical Works, Chicago, Ill.; Jos. Dixon Crucible Company, Jersey City, N. J.; Dressel Railway Lamp Works, New York; Flannery Bolt Company, Pittsburgh, Pa.; Franklin Manufacturing Company, Franklin, Pa.; Franklin Railway Supply Company, New York; Galena Signal Oil Company, Franklin, Pa.; H. G. Hammett, Troy, N. Y.; Hunt-Spiller Manufacturing Company, South Boston, Mass.; Jenkins Brothers, New York, N. Y.; Locomotive Superheater Co., Chicago, Ill.; Manning, Maxwell & Moore, New York; McConway & Torley Co., Pittsburgh, Pa.; National Boiler Washing Company, Chicago, Ill.; Nathan Manufacturing Company, New York; Niles-Bement-Pond Company, New York; Railway Materials Company, Chicago, Ill.; Rue Manufacturing Company, Philadelphia, Pa.; Safety Car Heating & Lighting Company, New York; Wm. Sellers & Co., Philadelphia, Pa.; Western Railway Equipment Company, St. Louis, Mo.; Westinghouse Air Brake Company, Pittsburgh, Pa.; Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.; New York Air Brake Company, New York.

The list following gives the names of

member companies, members of the association, and other companies, either officially represented, or in evidence by some representative, always, of course, of a genial disposition: Acme Machinery Company, Cleveland, Ohio; Ajax Metal Company, Philadelphia, Pa.; Armstrong Bros.' Tool Company, Chicago, Ill.; Barrett Machine & Tool Company, Meadville, Pa.; Bridgeport Chain Co., Bridgeport, Conn.; Buker & Carr Manufacturing Company, Rochester, N. Y.; Butler Drawbar Attachment Company, Cleveland, Ohio; Cleveland Twist Drill Company, Cleveland, Ohio; Coes Wrench Company, Worcester, Mass.; Detroit & Cleveland Navigation Company, Detroit, Mich; Duner Car Closet Co., Chicago, Ill.; Falls Hollow Staybolt Company, Cuyahoga Falls, Ohio; G. W. Hoffman, Indianapolis, Ind.; Magnus Metal Company, New York; F. W. Miller Heating Company, Chicago, Ill.; W. H. Miner, Chicago, Ill.; G. P. Nichols & Bro., Chicago, Ill.; W. H. Nicholson & Co., Wilkes-Barre, Pa.; Norwalk Iron Works, South Norwalk, Conn.; Philadelphia Turntable Company, Philadelphia, Pa.; Wm. B. Pierce Company, Buffalo, N. Y.; Pittsburgh Spring & Steel Company, Pittsburgh, Pa.; Power Specialty Company, New York; Prentice Wireless Systems, Toronto; Jos. T. Ryerson & Son, Chicago, Ill.; D. Saunders' Sons, Yonkers, N. Y.; Steel Car Forge Company, Pittsburgh, Pa.; Technical Equipment Company, New York; Westralian Improved Rotary Spark Arrester Company, New York; R. D. Wood & Co., Philadelphia, Pa.

The thanks of all those in attendance at the convention are due to the friendly and courteous attitude of the hotels on the official list, and some of the houses not directly on the boardwalk, especially the Monticello and the Ponce de Leon, deserve special mention.

The Angus Sinclair Company, publishers of Railway and Locomotive Engineering, had space on the main floor, and it was their pleasure to serve their friends in various capacities. Dr. Sinclair was present and greeted his many friends who called, while his associates and assistants endeavored in every way possible to make it pleasant for all whom they could serve.

A Wily Indian Chief.

When the Erie Railroad was under construction it was necessary to pass through part of the Indian Reservation in Cattaraugus County. The right of way agent expected to obtain permission to traverse the reservation without paying for right of way, but he found the Indian Council as keen for compensation as any white man encountered in New York State. Ten thousand dollars was demanded and that must be paid in gold.

The money was reluctantly paid, and the President of the Indian Council carried the gold home to his tent. He reported next day that a thief had crept into his tent and stolen the money, so that nothing remained to divide among the rest of the tribe. Guilt could never be brought home to the wily chief, but the belief was general that he was the thief.

Crazy on Sistom.

At a certain coal mine down in New Mexico the superintendent was greatly annoyed, from time to time, by employees moving into and out of the company's houses without due notification of their frequent changes of domicile. It became quite impossible to keep the rent accounts straight on the office books, and finally the superintendent, in his exasperation, resolved upon stringent measures. He therefore posted the following notice, which is given verbatim—orthography, syntax and all.

february the 11th.

Notice to all employes

aney Person or Persons that Mooves into A house Without My Consent shall be Put out Without anney Cemmony.

Dam it I Must and Will have some Sistom.

[Signed.] Hen Filster.

Not a Car Coupler.

Angus Sinclair, editor, tells this story: Some years ago when the railroad companies had decided to adopt an automatic coupler for cars, inventors all over the country began devising car couplers, and many of them visited William Buchanan, mechanical superintendent of the New York Central, to ask his opinion about their couplers. Mr. Buchanan got tired of these visits and began telling the inventors to consult Angus Sinclair.

One day a tall, lanky, farmer-looking man called on Mr. Sinclair, a black canvass bag in his hand, and explained that he had an invention that Mr. Buchanan recommended him to show to Mr. Sinclair. "Take it out and put it together on the floor," directed the editor. The inventor took out a variety of wooden parts and fitted them together while Angus kept studying the arrangement to find out how the invention would couple two cars together. After a few minutes of study he remarked: "Well, by man, you have devoted a great deal of work to that model, but it is the most extraordinary car coupler I have ever seen."

The inventor looked down with a meek smile and said: "That's not a car coupler; that's a potato digger.

A Typewriter of Long Ago.

The typewriter, which is now an essential apparatus in every well-managed office, began to come into use about forty years ago and is generally regarded as an invention of that period, which is not quite correct.

In 1714 a Scotsman named Henry Mill obtained a patent in Great Britain for a machine specified to impress letters on paper so exact that it could not be distinguished from print.

Mill was, however, ahead of his time. The machine was crude and required developing, but there was so little encouragement given to the inventor that he relinquished the idea of perfecting a writing machine.

He Knew Her.

Mrs. Highflier—Yes, George was away behind in his alimony, said money was tight, and all that, but I brought him around.

The Platonic Friend—How did you manage it?

Mrs. Highflier—Oh, I wrote him a little letter threatening to go back and live with him.—*Puck.*

Similar Case.

A self-made, self-satisfied, and self-assertive itinerant preacher was expatiating to a college graduate on his own eloquence. "Colleges," he declared, "ain't necessary when a preacher's got a genuine call to the ministry—I'm thankful to say the Lord opened my mouth without education." "That's interesting," returned his hearer. "Come to think of it, something like that happened several thousand years ago in connection with Balaam, wasn't it?"

A Measly Railroad.

"Speakin' o' close-fisted corporations," remarked Joe Holland, as he helped himself to another handful of prunes, "reminds me o' th' 'sperience I had with th' Skidoo Route in '73.

"Mandy an' me was takin' th' train to go an' visit her folks, an' when th' injine come 'long a doggone big hot cinder flew right plum into my eye.

"Well, I had a ter'ble painful time with that eye fer 'bout a week and fin'ly had t' go t' a oc'list an' have th' cinder dug out.

"And do y' think that measly railroad w'd pay my doctor bill 'r enythin'?

"Not them. When I went t' see th' supen'tendent 'bout it he threatened t' have me 'rested fer stealin' coal."

Teacher—Cold, you know, is merely the absence of heat. To what simple phenomenon do we owe the absence of heat during the winter months?

Class (in unison)—The janitor doesn't turn it on.

Symbiosis.

In an address delivered at the dedication of the Minot monument by Mr. Henry D. Estabrook the following remarks were made:

"In your reading, particularly of natural history, you must have stumbled upon that vermicular, twisty, rococo-looking word—symbiosis. It denotes the vital relationship between two organisms that have united their functions and their fortunes for mutual benefit; that is to say, for corporate profit. Whether such relationship is void under the Sherman Act, I am not prepared to say. Marriage itself is a civil contract. It probably is void under the Sherman Act, as it tends to monopoly and limits output, though it would depend somewhat, I take it, whether Cupid or cupidity was the negotiator of the contract. It was Charles Minot who brought about this state of symbiosis between the railroad and the telegraph, and the union has lasted to this day, in spite of Congress, the Interstate Commerce Commission, the Supreme Court of the United States, 'hell or high water.' Why, more than twenty years ago the Supreme Court decreed that the contract between the Union Pacific Railroad and the Western Union Telegraph Company was void as contravening some act of Congress, and that the parties to it must forthwith separate. Of course, the companies proceeded 'forthwith' to carry out the Court's decree and they have been at it ever since! Fact is, it can't be done! The union between the railroad and the telegraph is more than marriage, symbiosis or commercialism. The railroad and the telegraph are the Siamese twins of Commerce born at the same period of time, developed side by side, united by necessity. What the laws of trade and traffic have thus joined together it were folly to put asunder, and I am pleased to note that by a recent amendment to the Elkins Act, Congress has at last sanctioned the connection."

Get to Work.

If the skies look dull to you,
  Get to work;
If the atmosphere is blue,
  Get to work.

Fostering your discontent
Will not pay the landlord's rent;
Will not gain for you a cent—
  Get to work.

Brooding doesn't help your cause,
  Get to work.
Nothing gained by picking flaws,
  Get to work.

Weak are trampled by the strong?
You a victim of man's wrong?
"Stand the storm, it won't be long,"
  Get to work.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

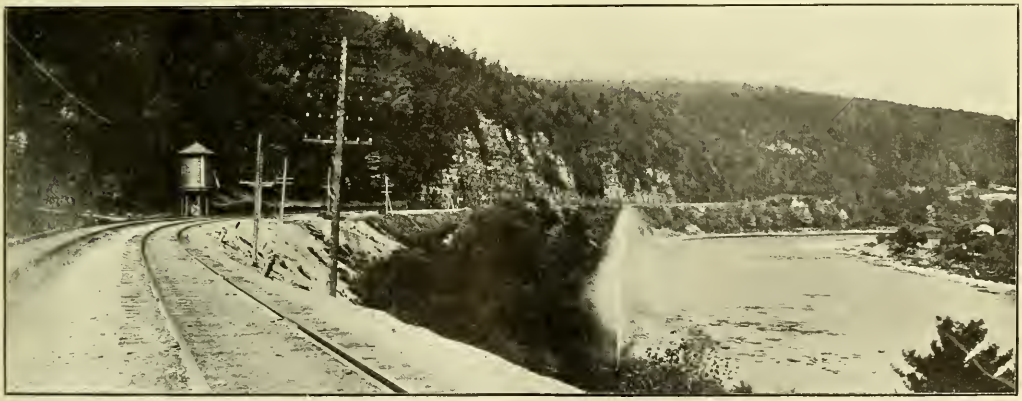
Vol. XXV. 114 Liberty Street, New York, August, 1912. No. 8

Past and Present of the Erie.

The early history of the Erie Railroad is of interest as illustrating the fact that all improvements in transportation have been made under accumulating difficulties, and in the face of strongly organized opposition. Previous to the introduction of railways it had been proposed to build a highway leading from New York to the Great Lakes, but although backed up by the leading men of New York State, the proposition never took form. When the railroads were being built in other States, the people of the Empire State haggled over the question of canals or railroads, and the canal scheme was adopted first, and the Erie Canal, to some extent, realized the dream of General Clinton, who had first advocated an "Appian Way" from the Atlantic to the Lakes. The canal company, secure in their monopoly of traffic, worked with ceaseless energy against the introduction of the railroad, and it was not until a series of small railroad branches, built at various points of the State had been in successful operation that the grand scheme known as the Erie Railroad took definite form. The connecting of the detached links of railroads and the completion of over 400 miles of a continuous track was something new in point of magnitude.

It would be idle to repeat the series of financial makeshifts and disasters that followed each other in rapid succession before a rail was laid. The company was organized in 1833, and in eight years a part of the line near Piermont was ready for laying. The question of the width of gauge was then an open one, and Chief Engineer Seymour decided that it should be six feet. It would have been well if other roads had followed the example, but they did not see fit to do so, and a change had to be made in the Erie many years afterward. Three eight-wheel engines, built by Norris, were the first in operation, owned by the company. Their cylinders were 13 ins. by 20 ins, the driving wheels 4 ft 6 ins. in diameter. The engines weighed about 15 tons. John Brandt, an eminent constructor, was the first master mechanic. He introduced the first ten-wheel locomotive. As the company progressed, an endless variety of locomotives appeared, until in 1870 no less than eighty-five different patterns were in operation. In comparison with other roads, the Erie had for many years the heaviest motive power in service in America.

In 1861, three locomotives appeared adapted for coal burning. Wood was becoming scarcer and dearer, and in 1872 the change from wood burners to coal burners was completed. At first the prejudice against coal burning was very great, and it is remarkable the effect that the opinions of the men employed in the mechanical department had on the management of the road. Schemes looking toward economy were, as a rule, opposed in these early days. Another peculiar feature was the almost absolute authority that the master mechanics exercised in selecting and suggesting various types of locomotives. The confusion in mechanical details was very great, and it was not until 1865, when Horatio C. Brooks, an eminent engineer, who had risen from locomotive engineer to be master mechanic and superintendent of the Western division, was appointed superintendent of motive power and machinery of the entire system, that some approach to order and general standardization began to appear among the mechanical curiosities that passed for locomotives. In 1869 Mr. Brooks established locomotive works at Dunkirk, N. Y., but his impress was left on the mechanical department of the road, and it has since kept well abreast of modern improvements.



ERIE RAILROAD. PARKER'S GLEN, ON THE DELAWARE RIVER.

Of the financial and other vicissitudes through which the road has passed we need not speak further than to state that they have been great and at times almost

overmastering. The dawn of a better day began with the present century, when Frederick D. Underwood was elected president, and the fortunes of the great road have been on the ascendent ever since. He is a fine example of the best type of railway man. As clerk, brakeman, conductor, foreman, superintendent and manager on various railroads he has gathered all the details of railroad work and has not been afflicted either with a swelling of the head or a contraction of the heart, diseases that are so common to men who rise in the world.

The road has been peculiarly fortunate in several ways, notably in freedom from accidents of a serious nature Safety has never been sacrificed to speed, and the fever of the maddening rush that saves a few hours, that are of no value to anybody, has never possessed the minds of the managers of the Erie. One notable exception may, however, be noted. Away back in the wartime a disastrous head collision happened on the curve of the scene shown in the frontispiece illustration. A train was bound west consisting of eighteen cars in which were 850 Confederate soldiers on their way to the prison camp at Elmira. A coal train consisting of 50 loaded cars from the coal mines entered the main line at Lackawaxen. The telegraph operator there gave the order for time clear to Port Jervis. While rounding the curve the trains came together. Some 60 Southern soldiers and 16 Union soldiers and trainmen were killed.

An investigation was at once held by the Associate Judge of Pike County who held that the operator at Lackawaxen was alone to blame for the collision. A pit 76 ft. long, 6 ft. deep and 8 ft. wide was dug, into which the bodies were buried without delay.

In our own day the Erie, stretching as it does from New York to Chicago, has tracks extending to 2,265 miles, with 1,403 locomotives and 50,796 cars, and takes its place among the foremost railroads in the world. In point of equipment it also takes its place among the best. In point of safety, as we have already stated, its record is not surpassed by any other road in the United States. In fast freight traffic it is earning an enviable reputation, and while there may be one or two passenger trains traversing the distance at a little higher speed, in the essential qualities of reliability and comfort, as well as punctuality according to schedule, there are no records that surpass those of the Erie.

ERIE RAILROAD CROSSING THE SUSQUEHANNA RIVER AT SUSQUIA, PA.

To state that the great highway has accomplished much in the country through which it passes is putting the facts mildly. It has already done what some of the roads in the Northwest and Southwest are just beginning to do. Cities have grown up in its pathway. The forests have given way to farms. The waste wildernesses have blossomed with beauty and manufactures have kept pace with agriculture all along the great highway. The scenic splendors of the Eastern division are the favorite haunts of summer excursionists from the great cities, and year by year thousands of fine residences are rising into beauty among the sheltered hills. The added value which the Erie has given to half a dozen states is incalculable. Its tens of thousands of employees are, as a rule, happy and prosperous. Its system of education of the younger mechanics, and to which we refer elsewhere in our columns, is already having the effect of furnishing mechanics whose efficiency is of the highest and best.

In brief, in the essential features of utility in its operation, in beneficence in its general effect, and in the gradual expansion of its scope the results are such as redound to the credit of the promoters of the great enterprise, and while, as we have stated, the Erie has had its dark days of trial, its future is full of promise. The success that has already come to it has the glory of the rainbow — it has gathered its iridescence from the storm.

Speed of Trains in Germany.

The speed of German passenger trains, even of the express trains, is not usually remarkable. The so-called "Schnellzuege" and "Eilzuege" ("fast" trains and "hurry" trains), for the first of which an extra charge is made, are both ordinarily deliberate in their movements, and accommodation trains and "locals" often spend much time between stations, usually in sight of each other.

However, German trains usually run on schedule time. The new summer time-table for the German State Railways Systems, just issued, shows some advances in speed, principally, of course, for through trains. The fastest train in Germany is the so-called "D-Zug 20" between Berlin and Hamburg, which maintains an average speed of 55.177 miles per hour. This throws into second place the express from Munich to Nuremberg (leaving Munich at 8:15 a. m.), which heretofore has been the fastest train in Germany with an average speed of 54.991 miles per hour. In the third place is an express train from Berlin to Halle with an average speed of 54.929 miles per hour, and the fourth place is held by the express from Freiburg to Appenweier, in Baden, with an average speed of 52.941 miles per hour.

ERIE RAILROAD CROSSING THE DELAWARE AT DEPOSIT, N. Y.

General Correspondence

Improved Blow-Off Cock.

Editor:

I am enclosing herewith photograph illustrating the details of a fluid actuated blow-off cock, which I have invented and

DETAILS OF BLOW-OFF COCK.

patented, the same being made of gray iron casting, the body consisting of two piece members, the one having a lug, which is anchored to the boiler by means of a short pipe nipple, and a stud is inserted in the lug and tapped into the boiler, making this a permanent rigid member, on to which is fastened by means of bolts and a flat gasket all the working mechanism, consisting of a cylinder made integral to the outer member of the body, in which is placed a rack having a piston head at either end with packing ring in each head. There is also a drop forge crank shaft having teeth made integral.

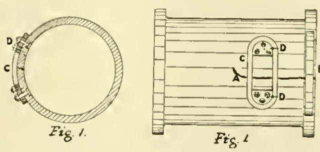
A bronze slide valve having the link that connects the valve to the crank, to-

IMPROVED BLOW-OFF COCK.

gether with bolts and caps and a hand lever which may be used by boiler washers in a roundhouse for putting water into or letting water out of stationary or locomotive boilers as the case may be.

In operation any number of blow-off cocks may be connected together and operated by means of controlling valves, two of which have been registered in the Patent Office, one consisting of a rotary having ports for actuating the go-ahead and back-up sanders, the bell, the bell in combination with the sanders, and closing positions of the blow-off cock, together with the opening position of the blow-off cock, which are at the extreme right, or left of the rotary controlling valve, or the same results may be obtained from the slide valve controlling valve, which consists of a number of slide valves, each opening a communication to and closing to the various fluid actuated devices on a locomotive.

One of the principal objects of this is to devise a means whereby the engineer may open the blow-off cock on the left



REPAIRING CRACKED CYLINDER.

side of the boiler as well as under the barrel of the boiler, together with the one on the right side, without calling on the fireman to perform such duties.

One of the most noticeable features with the use of the blow-off cock is the convenience and simplicity of operation. The fact remains that the blow-off cock is a necessity for successful operation of locomotives, and the more often it is used momentarily, the better result can be obtained in the maintenance of the machinery and boiler of the locomotive.

The photograph also shows a circle having cross members therein, which is placed on the boiler side of the blow-off cock to catch all foreign members such as particles of heavy scale flue thimbles, or pieces of stay bolts, as the case may be, from entering the blow-off cock.

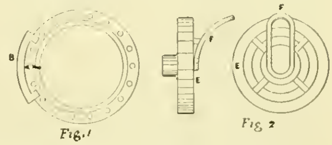
J. E. Osmer,
Master Mechanic,
C. & N. W. Ry.

Boone, Iowa.

Removing Pistons and Repairing Cylinders.

Editor:

On page 197 of the June issue of Railway and Locomotive Engineering there is an article from Mr. Markel describing a piston rod remover suitable for the alligator type of crossheads. We have a device in use on the Canadian Pacific shops here that differs somewhat from Mr. Markel's clever device, and is adapted more particularly for use on the

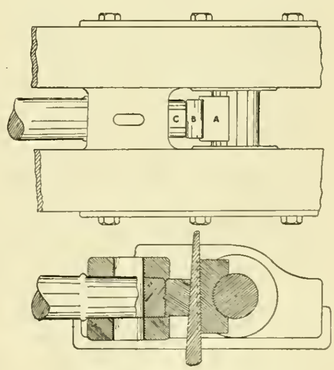


REPAIRING CRACKED CYLINDER.

four bar type of locomotive crossheads.

As shown in the accompanying drawing, A, is a block turned out on the one side so as to fit the main rod wrist pin, B, is a tapered key, and C is a round block adapted to fit the kind of piston rod end. This block is beveled or tapered to suit the taper of the key, and is also furnished with a small projection on the center of the straight side adapted to enter the center of the piston rod, and keep the block from slipping. A few blows on the key with a light sledge never fail to separate the piston from the crosshead.

The other drawing shows a very successful method of repairing cracked cylinders, the job having been done at the Glen Roundhouse on engines Nos. 902 and 914. The cylinders on both locomotives are 20 ins. in diameter, the



PISTON ROD REMOVER.

boiler pressure 190 lbs. Referring to Fig. 1, the crack in the cylinder is shown at A. The clamp, B, was made and put in place, as shown, while hot. The link strap C is made of iron 1 in. by $1\frac{1}{2}$ ins.,

and is 18 ins. long. The blocks, D, D, are 1 in. in thickness, and fit in the link. One of the blocks must first be secured in place by three tap bolts, then put on the second block and drill the bolt holes 1/8 of an in. beyond the points marked on the cylinder through the holes in the block. With one block properly secured in place, the strap link is heated red hot and placed over the secured block, and the second block is placed in position and secured in place as rapidly as possible. In Fig. 2, E and F is shown the link in a lathe for machining out the ends, in order to secure a close fit around the ends of the blocks.

J. G. KOPPELL.

Montreal, Canada.

Repairing Guide and Wrist Pin.

Editor:

Attached are sketches of a few shop kinks out of the ordinary line of repairs. The mechanical appliances at this point are not as complete as they will be by and by. At present a hand drill press, a blacksmith bellows and forge, and a grindstone are the principal shop tools. Fig. 1 shows a guide block with end and

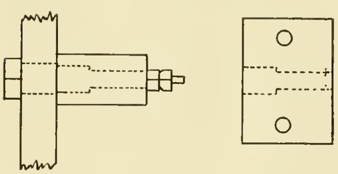


FIG. 1.

attached threaded portion broken off. A 1-in. hole was drilled in the center of the block as shown and countersunk 1¼ in. in diameter, made to allow about ⅜ in. of stock on top and bottom of guide block. A bolt 1¾ ins. in diameter was then reduced to fit the hole in the yoke and block and threaded for two nuts. This guide block, repaired in this way, has been in service over four months and shows no need of being renewed.

Fig. 2 shows a method of repairing wrist pin which had thread end broken off flush with the crosshead. Two holes were drilled as shown in the crosshead pin and a strap made of iron 1 in. by 4 ins., and drilled to fit. Two ⅞-in. studs were applied, long enough for strap and two nuts. To avoid the possibility of nuts becoming loose a piece of No. 16 sheet iron the size of the strap was placed between the nut and the strap and after tightening the nuts the edges of the sheet iron were turned up, locking the nuts securely. This crosshead pin ran three trips before being renewed and was perfectly secure.

Fig. 3 shows still another method that we have applied of holding a wrist or crosshead pin in place when the threaded end was broken off. A piece of boiler plate was fitted so as to rest on the head of the wrist pin and crosshead as shown and secured by top and bottom gib bolts. A repair of this kind requires some draw on top and bottom so that the center of the plate will rest hard against the head of the pin.

Fig. 4 illustrates a method that we have also used in repairing knuckle pins

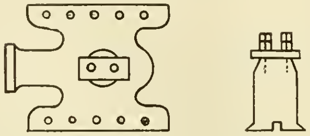


FIG. 2.

when threads were stripped or nuts missing. A ¾-in. hole is drilled through the threaded end, allowing about 1/8 in. draw, and then a ¼-in. spring cotter is fitted to drive with hand hammer splitting cotter afterwards. This job also proved very safe.

These repairs may not seem important, but they would be very serviceable to railway men situated as we are.

M. F. GOSSWILLER,
Locomotive Foreman.

G. N. Ry., Troy, Montana.

Valve Lubrication.

Editor:

I am much gratified to note the report from the recent convention of Master Mechanics treating on the progress made along the lines of increased service and durability of flanges and tires, due to flange lubrication.

As this service and durability exceeds the service and durability of valves and valve motion by 100 per cent., the question naturally arises. "Why do active and intelligent railway officials permit their power to go limping over their roads, consuming 25 per cent. more fuel and hauling less tonnage than it would with properly adjusted valves?" All mechanical men know that the frequent holding of engines out of service for valve facing and repairs on valve motion, is directly due to defective lubrication. These same

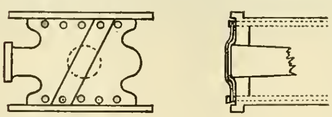


FIG. 3.

men know that the question of valve lubrication has gone through an extended period, more than twenty-five years, of threshing out without any effective improvements being added heretofore. This being true, can they hope to ever get away from the common system of lubrication by any other method than the trying out of scientific devices; such as were shown in the January and March editions of the RAILWAY AND LOCOMOTIVE ENGINEERING. The one shown in the January issue has, as far as tested out, proven that the valves received 100 per cent. lubrication. That the chest covers were not raised during two years of service, and that the valve motion was good for three and one-half years, by the renewal of the lower link pins.

It is my belief that if this device was tested out on the fire tube superheater, the question of lubricating slide valve engines using superheated steam would be forever and effectually solved. It is generally known by all intelligent railroad men that by reason of the defective system of lubrication now in general use, vast sums of money are yearly expended for fuel, material, supplies and labor needlessly, and then there is also to be reckoned the loss of the service of the engines while they are in the shop undergoing frequent repairs.

Can anyone suggest how this needless waste of money can be stopped in any other manner than by co-operation and the adoption of new and improved scientific devices? DANIEL MOREHOUSE.

Delphos, Ohio.

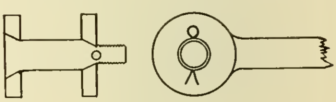


FIG. 4.

Senseless High Speed Trains.

Editor:

In reference to the high speed of trains, a subject which is constantly haunting some of us, it seems to me that it is up to the Master Mechanics' Association to show the cost of speeds in both passenger and freight service, on the level and on roads having heavy grades, with wind resistance calculated to average prevailing conditions.

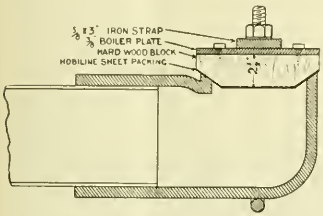
We, the Master Mechanics, should be able to tell the operating department the approximate cost of operating at any speed and what is the economical speed under various conditions. We should also include the hazard of accident and the cost of track and maintenance. I doubt if our roadway engineers are much better informed than we are on this phase of the subject. If the committee should conclude to go into this I would suggest that experiments be made on an oil-burning road having both level and mountain grades. If there is any reliable data on the subject I have never seen it. I believe there is but little sense and no economy in the high speed made throughout the country.

MEMBER M. M. ASSOCIATION.

Shimming Brasses.

Editor:

As a railroad machinist I have noticed the aggravating job of shimming a brass for driving box or bushings for side



SECTION VIEW, BLOCKING DRYPIPE.

rods. The usual method is to cut shim about twice as long as bushing and allow it to slip with the bushing and then have to keep cutting the shim off to allow for blocking under ram of piers. To avoid all this trouble and waste of material, I cut the shim the exact size, put a little white lead on crown of box or roof, as the case may be, then sprinkle a little fine sand on the white lead and put shim in place; the result is that the shim will adhere to the base and will not slip 1/32d of an inch. I have put in driving brasses as high as 35 tons, and the shim did not slip a particle. The boys certainly appreciate my method, to those I have shown, but I still see hundreds of machinists going through the old exasperating method. A. H. WALTERS.

Grand Junction, Col.

Piston Groaning.

Editor:

Regarding piston groaning, referred to in your Question and Answer department in July's issue of RAILWAY AND LOCOMOTIVE ENGINEERING, permit me to state that, in my opinion, it is not the piston that makes the noise referred to, but the cylinder packing. You will find that this groaning occurs when the locomotive is drifting down grade and when the throttle is shut. The cause of this is on account of the packing rings having become worn and the cylinder having become larger in certain parts, the result being that in drifting the packing rings do not fit the cylinder only at the bottom, and this partial bearing causes the groaning. You can use all the graphite that you wish and it will not cease, only perhaps for a minute or two, until the oil and graphite are rubbed away into the parts where there is no friction. When the engine takes steam again the friction is equalized all around the packing rings and the groaning ceases. When the rings are new and the cylinders in good condition the noise does not occur.

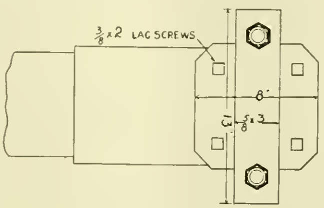
I have seen packing rings that were originally ¾ in. by ¾ in. worn so thin at the bottom that they would break with the least pressure. If new rings were fitted into the cylinders oftener there would be no groaning and less repair work. M. M.

Willow Springs, Mo.

Blocking Dry Pipe.

Editor:

Since the Federal boiler inspection law went in effect it requires the removal of stand pipe in dome after hydrostatic test, in order that inspector can get in boiler and examine all stays and braces. This caused considerable delay to engine, as we would find the throttle would leak and sometimes the stand pipe joint at dry pipe, which would not be known until hydrostatic test was put on, which caused the removal of stand pipe and grinding of joints and throttle before test could be put on boiler. After this was done it would again have to be removed to allow inspection, which was quite expensive as



BLOCKING DRYPIPE.
TOP VIEW OF BLOCKING.

to labor and delay to engine. To overcome this we immediately remove the stand pipe when engine is placed in shop, and if dry pipe ring joint is bad it is ground and blind joint applied, as shown by attached drawing. Dome cover is applied and everything is in condition for the hydrostatic test, after which the blind joint is removed and stand pipe applied. This joint will stand 300 lbs. pressure without leaking, and saves us from ten to fifteen hours' time on every engine that is tested. Drawing plainly shows the simplicity of the idea, and as all railways have to make this test I believe it will interest a number of readers of RAILWAY AND LOCOMOTIVE ENGINEERING.

CHAS. MARKEL,
Shop Foreman,
Clinton, Iowa. C. N. W. Ry.

Frame Breakage.

Editor:

In the July issue of RAILWAY AND LOCOMOTIVE ENGINEERING there is a very interesting article on the breakage of frames, and it recalled to me a conversation that I had with a leading railway man here, who claimed that the increase of frame breakage was caused by the wheels being improperly balanced, especially the main driver, as they are very heavy on certain classes of locomotives. Reference might be made to the M-2 or 4-8-0 class that are equipped with the Walschaerts valve gear. The main wheels have not a crescent shaped counterbalance attached to the wheels as is usually the case, but the counterbalance takes up half the wheel, and only four open spokes are left.

As the main drivers are the second pair of wheels the main rods are consequently short, and this adds to the strain on the frames. There is also a tendency to increase the strain by having the shoes and wedges too tight, and not receiving the proper amount of lubrication. In any event the number of breakages, as your correspondent states, are increasing in spite of all the improvements, and it is urged that some of our constructing engineers turn their attention to frame breakages, and devise means to remedy the defect.

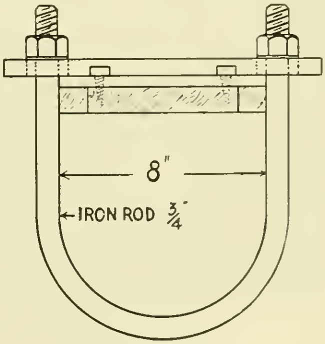
M. K. STRAYER.

Portsmouth, Ohio.

Prosperous Communists.

There is on the Chicago, Rock Island & Pacific Railway, near Idaho City, an agricultural communistic society called the Amana Society, but originally called Dunkard, that are highly prosperous and have successfully resisted the inroads of individualism. They are of German origin of peculiar religious tenets for which they were driven out of Germany about 1720.

The society has about 2,000 members, who work a tract of land comprising 26,000 acres. They have mills, shops and factories, as well as farms, and the motto of their mill is, "Only honest goods of



BLOCKING DRYPIPE.
SHOWING STRAP FOR HOLDING BLOCKING.

the highest grade made here." Everybody who buys goods from the Amana Society feels assured of receiving his money's worth.

Erie Apprentice Schools

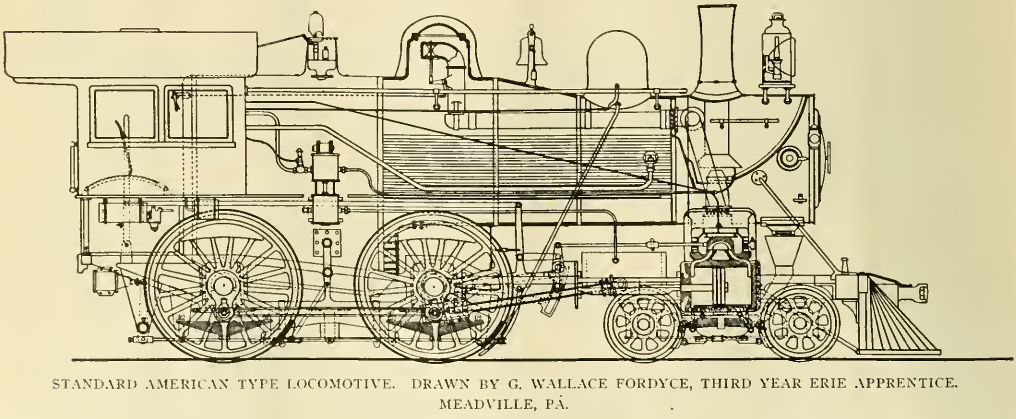
By ANGUS SINCLAIR, D. E., Special Instructor, Erie Railroad

The management of the Erie Railroad Company, which is noted for fair dealing towards all employees, were early in the field in providing technical instruction for the apprentices working in the repair shops, connected with the company.

The scheme of industrial education, as announced by the Erie management, was as follows: "The Erie Railroad Company, in the establishment of apprentice schools at the different shops, has for its primary object, not the making of mechanical engineers out of shop workmen, but the making of first-class skilled mechanics to recruit the shop forces with men trained and educated in Erie standards and Erie in the latest methods."

In June, 1908, it was decided to establish a thorough apprenticeship system to train young men, not only to competency and skill in the mechanic arts, but also to interest in business, loyalty to the railroad and familiarity with Erie standards and methods. With these objects in view the company established apprentice schools at Meadville, Hornell, Susquehanna and Dunmore shops, and some time later at Port Jervis. The company furnishes class rooms, heat and light, drawing tables, drawing instruments, blackboards and all necessary material for conducting the schools. The only requirements imposed upon the apprentice is regular attendance at the the schools and intelligent attention to the studies.

APPRENTICES, ERIE RAILROAD SHOPS. MEADVILLE, PA. 1912.



STANDARD AMERICAN TYPE LOCOMOTIVE. DRAWN BY G. WALLACE FORDYCE, THIRD YEAR ERIE APPRENTICE. MEADVILLE, PA.

Instruction in the classes cover the fundamental rules of arithmetic, common and decimal fractions, proportion, simple problems of interest tables and weights, the elementary principles of plain and solid geometry, mechanical drawing, practical and theoretical mechanics, and instruction in Erie standards pertaining to the construction of cars and locomotives, as well as lessons in successful and economical operation of same.

At present the officials in charge of the apprentice schools are: W. S. Cozad, shop specialist, Meadville, Pa.; E. W. Robbins, instructor, Meadville, Pa.; F. R. Stewart, intructor, Hornell, N. Y.; E. B. Waller, instructor, Susquehanna, Pa.; H. W. Mosley, instructor, Port Jervis, N. Y.; F. M. Wallace, instructor, Dunmore, Pa.

The technical instruction which the apprentices receive is only secondary to the shop training, which is peculiarly thorough and properly calculated to produce first-class workmen. There are eleven departments where apprentices are employed, viz.: Machine shop, blacksmith shop, boiler shop, tin and pipe shop, painters, electricians, car builders, cabinet makers, carpenters, patternmakers and foundry. Every effort is made in each of the shops to give apprentices the opportunity to learn all details of the trade. The scope of the work all over may be inferred from the rules in practice for machine shop apprentices, as follows:

Apprentices in this department will be given a general knowledge of all the different classes of work within the specified time of three years, as indicated by the following schedule: Lathes, six months; planers, three months; shaper, three months; slotter, two months; boring mill, two months; vise work on rods, three months; vise work on motion pistons, crossheads, etc., four months.

Erecting shop.—Frame work, shoes and wedges, wheeling engines, putting up spring rigging, engine truck work, expansion gear, etc., six months. Work above running board, consisting of hand rails, hops, whistles, boiler mounting, and all similar work, three months. Putting up motion work, setting valves, turning guides, putting in pistons, applying steam chests, etc., four months. Total, three years.

APPRENTICES, ERIE RAILROAD SHOPS. PORT JERVIS, N. Y. 1912.

APPRENTICES, ERIE RAILROAD SHOPS. DUNMORE, PA. 1912.

The fourth year will be spent, when possible on work on which the apprentice has the least knowledge; otherwise he will be located to meet the shop requirements.

The tool room and the air brake departments will be treated special, and a number of apprentices kept in these departments continuously, with the understanding that they are to become specialists in these particular classes of work. Apprentices in these departments will be given a three-year course, as follows:

Handing out tools, two months; operating tool and drill grinders, two months; shaper, two months; milling machine, three months; lathe, four months; vise work on die sinking, making and general repairs to such tools as are used on the various classes of work in the different departments of the shop.

In the Air Brake Room. Overhauling and applying brake rigging, three months; air pumps, four months; lubricators, engineers' valves, injectors, etc., four months; reducing valves, cut-off cocks, steam and air gauges, globe valves, water

glass and steam gauge cocks, pops and whistles and all work handled in this department, seven months. Total three years.

Four to six months of the fourth year of apprenticeship in these departments shall be served in a roundhouse, where the apprentice will be given an opportunity to study the defects common to locomotive mechanism. A number of apprentices who display special aptitude will be kept on the surface table at times.

In shops where there are 50 apprentices two of them will be kept in the Machinery Repair Gang for at least three months.

The foregoing details of the opportunities given to the machinist apprentice indicates that the Erie management spare no pains to convert their apprentices into skilled workmen. Well founded complaints have often been heard that apprentice boys were kept at rough elementary work that involved so very little skill that youths could not learn the trade they were underpaid to work at. This certainly cannot be said of the apprentices employed in the Erie shops.

Most of the boys have taken quite earnestly to the school work and indications are that most of them appreciate the advantages they are enjoying. Several of the apprentices who have finished their time have been made foremen and advanced to other positions of responsibility which the scientific training had fitted them to fill.

Mr. F. M. Wallace, who has been in charge of the toolroom of the Erie shops at Dunmore, Pa., has been advanced to take charge of the apprentice school at that place. He will impart both technical and practical instruction. Mr. Wallace is a most ingenious mechanic and has devised a great many labor and time-saving inventions.

APPRENTICES, ERIE RAILROAD SHOPS. SUSQUEHANNA, PA. 1912.

APPRENTICES, ERIE RAILROAD SHOPS. HORNELL, N. Y. 1912.

Fifth Annual Outing of the Erie Foremen at Dunmore, Pa.

The annexed picture was taken when the Erie shop foremen at Dunmore were on their fifth annual outing. They form a group of very intelligent looking men but how such men were prepared to display themselves in a group without having the female part of their community in evidence is something we do not understand.

Mr. W. S. Haines, master mechanic, heads the list and along with him are F. M. Wallace, C. Warner, J. H. Reed, F. J. Daily, J. Fitzsimmons, J. Craig, J. Duffy, S. Fredimruck, O. Thompson, C. Beckendorf, J. Clauser, C. Schultz, C. Dierp, W. Cummings, M. Taylor, C. Lang, A. Ketz, A. Barnes, R. Wormbacker, K. Dierts, P. Kims, W. Kiselan, M. Stone, S. H. Ward, G. Sly, E. W. Jackson, J. Clay, H. E. Blackburn, G. Boose, J. Roache, C. Wagner, J. Jackson, W. P. Pine, C. Tollen, R. Winterstein, C. Sueager, T. Bruck, J. Evans, J. McAndrews, R. Winters and J. Clouser.

W. S. HAINES, M. M., AND SHOP FOREMEN, ERIE RAILROAD SHOPS. DUNMORE, PA. 1912.

Pacific Type Locomotives for the Norfolk and Western

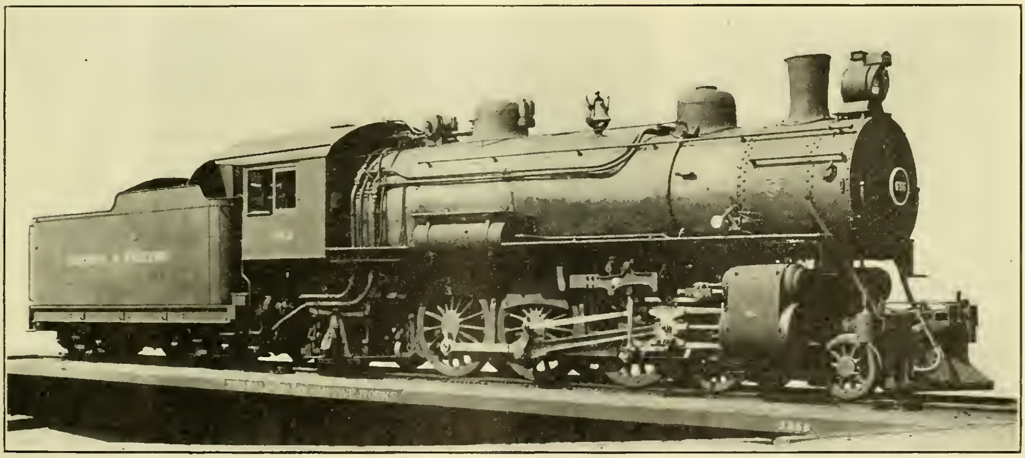
The Norfolk & Western has recently received six passenger locomotives from the Baldwin Locomotive Works. These engines were built in accordance with drawings and specifications furnished by the railway company, and are similar to locomotives of the Pacific type which have been handling the passenger traffic on this road for several years. Experience has given opportunity to revise details. The new locomotives use superheated steam, which will add materially to their efficiency. The tractive force exerted is 34,400 lbs., and with 163,850 lbs. on the driving wheels, the ratio of adhesion is 4.76. The safety valves are set at 200 lbs.

The boiler has a tapered connection in the middle of the barrel, which increases the diameter from 74 ins. at the first ring to 84 ins. at the third. The dome is made of a single piece of pressed steel, and measures 30 ins. in diameter and 22 ins. in height. A notable feature is the mud ring, which is 7 ins. wide all around; so that there is ample room for circulation in the water legs.

The grate bars extend entirely across the furnace, and are arranged to rock in two sections. The shaking rigging, ash-pan slides and fire door are operated by pneumatic power.

The superheater is of the Schmidt type, and is installed in 30 tubes, each 5⅜ ins. in diameter. The live steam pipes are placed entirely within the smoke box, and the steam is conveyed to the steam chests through passages which are cored in the cylinder castings. The steam distribution is controlled by 12-in. piston valves. These valves are of cast iron in one piece, with three rectangular packing rings in each end. They are driven by Baker gear, and are set with a lead of 3/16 ins.

The main frames are 5 ins. wide, with separate rear sections of slab form, 2½ ins. wide. Broad transverse braces span the top rails between the driving axles, and the lower rails are braced transversely adjacent to each pair of pedestals. The boiler waist sheets extend down to these lower braces, and are bolted to them. The pedestal binders are held in place by three bolts in each end. The equalizing beams and spring hangers are of forged iron. The rear truck is of the Hodges type, with outside journals and spring hangers jointed to take the side swing. The weight is transferred to the back spring hanger through a cast-steel bracket which is bolted to the rear frames. This bracket supports an expansion plate, which in turn supports the side of the mud ring near the back. The mud ring is also carried on expansion plates at the front and rear.



4-6-2 TYPE OF LOCOMOTIVE FOR THE NORFOLK & WESTERN RAILWAY.
W. H. Lewis, Superintendent of Motive Power. Baldwin Locomotive Works, Builders.

The details of the design have been carefully worked out, and the locomotives are well fitted to meet the service conditions on the Norfolk & Western. The principal dimensions are as follows:

Gauge, 4 ft. 8½ ins.; cylinder, 22½ x 28 ins.; valves, balanced piston.

Boiler—Type, wagon top; material, steel; diameter, 74 ins.; thickness of sheets, ¾ in. and 13/16 in.; working pressure, 200 lbs.; fuel, soft coal; staying, radial.

Firebox—Material, steel; length, 100⅛ ins.; width, 64¼ ins.; depth, front, 78¼ ins.; depth, back, 74½ ins.; thickness of sheets, sides, ⅜ in.; thickness of sheets, back, ⅜ in.; thickness of sheets, crown, ⅜ in.; thickness of sheets, tube, ½ in.

Water Space—Front, 7 ins.; sides, 7 ins.; back, 7 ins.

Tubes—Material, steel; thickness, .150 in.; .110 in.; number, 30, 222; diameter, 5⅜ ins., 2 ins.; length, 20 ft. 1 in.

Heating Surface—Firebox, 192 sq. ft.; tubes, 3,167 sq. ft.; total, 3,359 sq. ft.; grate area, 44.7 sq. ft.

Driving Wheels—Diameter, outside, 70 ins.; diameter, center, 62 ins.; journals, main and others, 10½ ins. x 12 ins.

Wheel Base—Driving, 12 ft. 6 ins.; rigid, 12 ft. 6 ins.; total engine, 32 ft. 10½ ins.; total engine and tender, 64 ft. 9½ ins.

Weight—On driving wheels, 163,850 lbs.; on truck, front, 39,200 lbs.; on truck, back, 46,200 lbs.; total engine, 249,250 lbs.; total engine and tender, 420,000 lbs.

Tender—Wheels, number, 8; wheels, diameter, 33 ins.; journals, 5½ ins. x 10 ins.; tank capacity, 9,000 gals.; fuel capacity, 14 tons; service, passenger.

Engine equipped with Schmidt superheater. Superheating surface, 756 sq. ft.

Safety Committees.

It is gratifying to observe that the railroads are rapidly taking up the matter of appointing special safety committees. Among these the Illinois Central has adopted a graphic method of impressing upon employees the importance of the subject. Illustrations are circulated showing some of the common ways in which accidents are caused. Pictures and names of employees recently killed or injured by reason of negligence are also published.

General Foremen's Department

International Railway General Foremen's Association.

The annual convention of the International Railway General Foremen's Association was held at the Hotel Sherman, Chicago, Ill., on July 23, 24, 25 and 26. The meeting was the largest that has yet been held under the auspices of the association, and the proceedings were of a very interesting kind. The officers elected at the last annual meeting are all thoroughly representative railway men and it was gratifying to observe that they all showed a warm and intelligent interest in the welfare of the association. The President, Mr. F. C. Pickard, has been particularly active in advancing the well-being of the association and has been ably supported during his term of office. Mr. William Hall, the Secretary of the Executive Committee, has also shown marked ability in the discharge of his duties and spared no pains in attending to the preparatory work in connection with the convention. The reports of the officers showed a considerable increase in membership during the year and gave every indication of a continued increase in the popularity and work of the association in the future.

The various topics selected at the last year's meeting and submitted to special committees were discussed and the papers submitted by the committees were generally approved of. Mr. W. G. Reyer, General Foreman, Nashville, Chattanooga and St. Louis Railway, Nashville, presented a report on the subject, "How Can Foremen Promote Efficiency?" In the course of his report Mr. Reyer came out very strongly in favor of the step rate of pay and claimed that "men in all walks of life should be paid according to their individual merits. We are not all alike. Some men are naturally quick, both to grasp an idea and to do the work, and will push the work with energy. Others will work all day and accomplish very little, while some men can do only one class of work, other men are all around mechanics. My plan is as a man progresses and broadens advance him. I believe in paying the best established wages to the hustler and thinker.

"I have made it a practice to hire handy men, whose general appearance and manner of speech show they are capable of learning. I tell them what I will start them at and also tell them it's 'up to you to make good, and get your wages raised.'

"The workmen and the company both gain by the step rate of pay. The workman gains because he knows he has to accomplish something to make good and get his increase in pay. For this reason he grasps and pushes at every opportunity to advance his work. He begins to study out plans to shorten his operation and thinking ahead, and does not wait until he needs anything and then have to hunt for it. He soon finds that if he will exercise his mind a little more he will accomplish more in a day with less labor."

In regard to the method of keeping note of work the report recommended the method of numbering the pieces of work,

F. C. PICKARD,
President, General Foremen's Association.

Mr. Reyer stating "that it works satisfactorily. All stock work is done by shop numbers. The department that originates the work and stamps ticket with lot number, describing what is to be manufactured; all sub-requisitions bear the same number and are sent to any department that he may require material or labor for to complete the work. Each department finishing material or labor, places the weight, kind of material and hours it took to do the work. When work is completed tickets are placed on file and collected by messenger daily and delivered to superintendent's office, where an account is made out.

"We try as near as we can to run our engines 100,000 miles. That is, our passenger and freight engines. Our switch engines we try to run from 40,000 to 60,000 miles. The superintendent's office gets reports from traveling engineer as to general condition of engine. Where the general foreman can get information on any engine that is to be shopped and has a large enough force and machines for stock work, this information would be of great service and should naturally shorten time of engine in erecting shop. To illustrate: Should any engine need a new firebox, cylinders, cab, driving boxes, shoes and wedges, tires, crank pins, rod brasses or tank frame. If this information is in the general foreman's hands 30 days before engine is sent to him he would get busy and advise the different departments that a certain engine would be shopped in 30 days and would require certain repairs, for him to look out and see that parts required were ready for engine."

Mr. Reyer concluded his paper with details of shop management and operations and was followed by Mr. C. L. Dickert, Master Mechanic, Central of Georgia Railway, Macon, Ga., who reported in favor of methods that embraced "a system of furnishing information on the condition of all power at all times. The form should be worked up each month, showing the condition of each engine; when they are expected to be shopped, the class repairs they are to receive, condition and life of firebox, boiler and flues, condition of frames, cylinders, machinery, cistern and tank trucks, tire wear and thickness, and general condition of engine, whether good, fair or bad. In going over this form each month with the master mechanic we select the engines that are to be shopped within 30 days. I then fill out Form No. 1698 in order to cover and send to the superintendent of motive power, who returns them showing mileage the engine has made and authorizing their shopping.

"In going over this form each month I know exactly what engines will need new tires when shopped; I look over my stock and see what I have on hand and order just enough for the engines that are to get them. We have an engine that the life of the firebox is one year; this gives me a year's notice if necessary. By this means you can figure very closely just what heavy repairs are to be handled and make your plans to suit."

The subject of "Shop Supervision Under Local Conditions" was ably handled by Mr. W. W. Scott, General Foreman, Pere Marquette Railway, Saginaw, Mich. Mr. Scott recommends "that shop engines should be listed 30 or 60 days in advance of shopping. By this method you have arranged for the necessary material, there-

by making rush requisitions on your store department unnecessary. It keeps your department foreman keyed up to the highest point, so that his department will not have to explain a delay. It also gives your store department sufficient time to order and receive material.

"Local conditions greatly determine the

W. W. SCOTT,
Vice-President, General Foremen's Association.

point of economic shop supervision. Your shop output may be at the mercy of a storekeeper who is not of a progressive and agreeable nature, and who takes particular delight in withholding information relative to material that you ought to know about. Some railroad companies are unfortunate enough to have such men

T. F. GRIFFIN,
Vice-President, General Foremen's Association.

looking after their stores, a condition to say the least is deplorable. It stifles the ambition of any general foreman to be misled on a material proposition, and it leads to a rapid decline of efficiency in shop management."

The subject of "Shop Specialization, Work and Tools" was reported upon by Mr. W. T. Gale, Demonstrator, Chicago and Northwestern Railway, Chicago, Ill. Mr. Gale presented some excellent illustrations of the methods in vogue in various shops and laid great stress on the value of specialization, which, he claimed, "was largely due to economic conditions of our day. It is the result of close competition in all lines of trade, business and professions. Today competition is more keen than ever. It is essentially the age of trained men, of specialists, of men who know a given line well. There is small demand for the jack-of-all-trades. It is the expert who is accomplishing the big things, and it is the expert who is getting the reward for his knowledge and ability. It is an era of the specialist who gets special results. Your artisan is no longer the jack-of-all-trades and master of none, nor even good at all, but is master of one or a division of one, and that only. This is the age of achievement, in the making of which all activities are being elevated to the standard of efficiency. It is the dawn of a new era, an era of specialization in every line of endeavor, with the specialist ever peering into the future for his oportunity. This is the American idea and this is why America is leading the way."

Mr. William Hall, General Machine Shop Foreman, Chicago and Northwestern Railway, Escanaba, Mich., presented an excellent paper on the subject of "Roundhouse Efficiency," in the course of which he stated that "every engine house should have its own equipment of tools, and of the modern kind, entirely separate and distinct from the back shop—the two should be segregated. In fact, it would be far better if they were far removed from each other, as then the roundhouse would not be depending upon the back shop for support. If any branch of railroad service that needs and should have good tools, it is the roundhouse. Engine houses at division points should have an engine lathe, a small lathe for brass work, a drill press, a small planer, and an emery wheel, and such other tools as will tend to facilitate the work, the number and size to be governed by the size of the house; also a sufficient number of men to insure prompt returns. To promote roundhouse efficiency considerable attention should be paid to shop kinks—taking advantage of every device that will facilitate matters and decrease cost, such as air hoists, small portable cranes, portable benches, etc.

"The next essential thing in the promotion of efficiency is a good organization, without which it is useless to look for efficiency. The work, as far as practicable, should be specialized, as more will be accomplished by this method, men becoming more proficient along their different lines and will use their ingenuity in devising little devices and kinks to help themselves along, and which, in a great many cases, prove to be quite profitable, but if thought advisable the men could be changed around at intervals, which might stimulate their interest in the work. Another aid to roundhouse efficiency is a hot-water plant for washing out purposes and refilling boilers after washing out, thus avoiding undue strains and stresses,

L. A. NORTH,
Vice-President, General Foremen's Association.

also much time is saved, especially in cases of emergency."

"The Reclaiming of Scrap" was ably treated by Mr. C. H. Voges, General Foreman of the Cleveland, Cincinnati, Chicago and St. Louis Railway, Bellefontaine, Ohio. In the course of his paper he stated that "taking into consideration that

W. SMITH,
Vice-President, General Foremen's Association.

No. 1 and No. 2 wrought iron, and looking at it from an economical standpoint, it would pay any company where a large quantity of scrap accumulates to install a forging furnace and a large steam hammer to be used in forging this material into billets so it can afterward be drawn out for the required purpose, as this is

much cheaper than purchasing it from outside points. This also refers to cast-iron and brass.

"We have to keep a large amount of cast iron and brass castings on hand in order to protect ourselves and outside points and make the proper output. It would pay any large railroad company to install a foundry for both cast iron and brass, as all railroad companies have different classes of engines which require different castings, and this necessitates us carrying a large supply on hand. In my opinion, it would cut the amount of stock that has to be carried on hand down to a minimum. If we had a foundry at the plant and wanted half-moon brasses, side rod bushings, back-end main rod brasses, etc., I could order them on short notice and have them ready for use the next morning. The same refers to grates, side rests, packing studs and any other patterns we have to carry a large quantity in stock to protect the power, as brass runs into the thousands of dollars very fast."

Mr. Voges added many interesting details of the saving that can be effected by the proper and systematic reclaiming of scrap, and closed with a description of a waste cleaning plant that was at once cheap and effective.

The same subject was also dealt with by Mr. Hall, Escanaba, Mich., who claimed that "a reclaiming plant should be established at all division headquarters, with a sufficient force to handle it economically, and would prove to be a paying investment; the plant to be in proportion to the size of the division and the amount of business done, thus avoiding shipping to headquarters.

"The Chicago and Northwestern Railroad has gone into this reclaiming of material on a large scale and in various ways.

"At our Chicago shops we have a reclaiming shed 24 feet by 176 feet, and it contains the following tools: One steam hammer, one bulldozer, one double shear, one large single shear, three machines for removing nuts from bolts, one 25-pound spring hammer and one Bradley hammer. This shed was built from lumber reclaimed from old torn-down cars, and the tools were removed from the blacksmith shop to make room for more modern tools. All the reclaiming is not done in this shed, however, as a large quantity is handled in the blacksmith shop and the machine shop. In the reclaiming shed all usable bar iron is straightened and cut up for bolts, etc., and the scrap is sent to the blacksmith shop, cut up, heated in a large furnace, and then hammered into slabs, and they in turn are converted into axles."

Mr. Hall's array of facts and figures specifying in detail the amount saved in a single day by a thorough system of scrap reclaiming was surprising in point of magnitude, and clearly showed that the subject is one of the most important in railroad work.

Mr. T. H. Ogden, General Foreman of the Santa Fe Railway, Los Vegas, N. M., also contributed a paper on the same subject, in the course of which he stated that "surplus material fit for service will accumulate at division points, and, if properly reclaimed, this surplus material may be turned back to the storehouse and credit furnished, which will still reduce in a manner cost of operations. In this case the working memorandum should be furnished covering reclaimed material and complete instructions for accounting for all such material which may be returned to stock and a credit given our department. For instance, it may be required that all serviceable material may be returned to stock until needed. This action affords a record on the stock books for any available material for use and very often enables the redistribution of such material, avoiding the purchase of or issuance of new. It is my opinion it should also be required in order to have account

WM. HALL,
Secretary-Treasurer, General Foremen's Association.

properly charged so as to credit the account originally charged with any and all serviceable material that accumulates about the shops and roundhouse; this in order to have our cost of repairs to the individual engine properly distributed and each item of reclaimed material entering into the repairs of the engines be drawn by requisition and charged out from reclaimed material. This will also give us a credit on our operating accounts from reclaimed material picked up. Parts removed from locomotives which are serviceable after repairs have been made and are taken into stock at the time of removal by credit being allowed therefor on requisition for new material at current prices of new material, less cost of repairs."

The last of the special subjects, "The Relation of Tests to Shop Efficiency," was treated by Mr. J. S. Sheafe, Engineer of Tests, Illinois Central Railway, Chicago, Ill. Mr. Sheafe quoted numerous instances of the value of tests, especially in the quality and kinds of steel used. He also pointed out the prime importance of co-operation between individuals and departments. Harmony begets efficiency and both are the real tests of the highest accomplishment. He deprecated the use of red tape, which is largely a waste of time, and stated that "a general foreman has no time to write letters, figure out problems or worry over matters of faulty material or construction. The output of his shop, in quantity and quality of work, is of vital importance to the railroad's operation and means that he is helping the road vastly more by directing his subordinates and generally overseeing each bit of work, than he would be by carrying a worrying load that belongs on other shoulders. He should be relieved of this. He should be relieved of all detail, and on many roads this is being realized by the management.

"We are all familiar with experiences of too much of the theoretical or technical.

"The opinion of the practical mind is of too much value to be overlooked, even in questions arising in the laboratory. That 'cause precedes effect' is apparent to the general run of foremen is evident. It is not necessary for a man to know how a thing is done to know whether it is well done. This applies to all things, whether a surgical operation or making a weld in the blacksmith shop.

"No mind can accomplish any one thing alone and unassisted. There will be always found the collection of talent which makes the seemingly impossible easy.

"Good results never come spontaneously. Even with proper effort they are many times too slow.

"Weeds alone come unbidden and stay. Good will result only from effort, and it will be found on both sides that the problems arising are more easily solved by the assistance always available if it is solicited in the right manner.

"Form between railroad men should be eliminated—that spirit of disinterestedness as to each other's work."

The proceedings throughout were conducted with the utmost harmony, and Mr. Pickard proved himself an accomplished parliamentarian. His rulings met the approbation of the entire convention.

The discussion that followed the presentation of the various papers brought out much reliable information, and the publication of the complete details in book form will be a contribution of real merit to the railroad literature of our time.

The election of officers resulted as follows: President, Mr. F. C. Pickard; vice-presidents, Messrs. W. W. Scott, T. F. Griffin, L. A. North and W. Smith; secretary-treasurer, Mr. Wm. Hall.

Use and Care of Files.

The novice is liable to use the first file that comes to hand, sawing backward and forward with equally heavy pressure, but he will soon discover that a tool cuts on the forward stroke only, and that if he relieves the pressure on the return movement he will husband his strength, and the teeth of the file also. In time he will buy 12-in. files and be particular as to the use to which they are put. It is poor practice to employ a new file for work on solder. These members when new and fine should be reserved for brass and similar metals. To file well is quite an accomplishment, as the novice will probably note after surveying his attempts to obtain a smooth and even surface.

The color of the file should be a dull, silvery gray, free from spots or mottling, except at the end or tang, where it is tempered. Files should be kept in a rack by themselves, and should not be thrown in a drawer among other tools, and if a file or two be carried on the car, they should be wrapped separately in paper or cloth to prevent injury.

Grindstones.

A grindstone 3 ft. in diameter, with a 4-lb. face—that is, 4-in. thick—will weigh nearly 425 lbs., and may be driven with comparative safety at from 2,000 ft. per minute to 2,500 ft. per minute, or from 200 revolutions per minute to 225 revolutions per minute. To reach such speed the stone to be safe must be true in its periphery, and the lower part must not rest in water. This last feature makes the stone heavy at that part, and would produce a shock at each revolution and ultimately produce fracture or a "stone burst," a very undesirable feature, from the fact that the flying pieces have no respect for anything and no specific direction, but invariably fly at a tangent.

Hollow Staybolt Iron.

It is interesting to learn the details of the severity to which the Falls Hollow Staybolt Iron has been frequently tested as to tensile strength requirements and found to exceed them in elongation and reduction of area, which indicates unusual ductility. The specifications now in general use are those adopted by the American Society for Testing Materials, and these require a tensile strength not less than 48,000 lbs. per sq. in., not less than 28 per cent. elongation in 8 ins., and a reduction of area not less than 45 per cent.

The vibratory tests in the same specifications require that the test bar shall endure a minimum of 6,000 revolutions when a threaded specimen fixed at one end has the other end moved in a circular path while under a tensile load of 4,000 lbs. The circle described shall have a radius of 3/32 at a point 8 ins. from the fixed end of the specimen. Seven samples of Falls Hollow Staybolt Iron were tested under the above conditions at Purdue University, and the average number of revolutions required for rupture was 10,378. The double bending test requires that the bar shall be closed in both directions without flaw. The illustrations show how well the Falls Hollow specimen has met this requirement, as well as the more severe test by bending after the specimen was threaded.

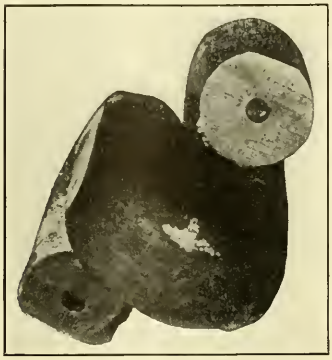


FIG. 1. SHOWING COLD BENT BAR.

Fig. 1 represents a bar 1⅛ in. in diameter, bent cold flat on itself and retaining a smooth surface with no rupture. The extreme ductility of this iron is shown by the distance the molecules had to float without rupture in following the curve described in bending the bar.

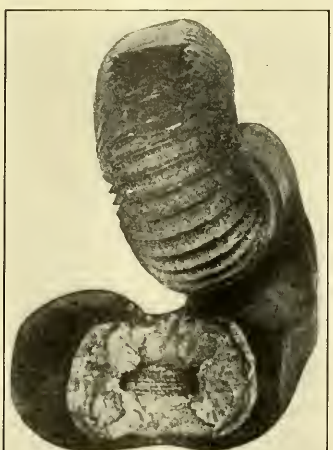


FIG. 2. SHOWING BOLT BENT ON ITSELF

Fig. 2 represents a bar 1⅛ in. in diameter, nicked 1/16 in. deep one-half way around and bent flat on itself to produce rupture and show the fibrous structure of the iron and the stretch at the hollow portion. It also shows the standard V-thread 12 per in. when bent flat on itself. Although each thread is the equivalent to the nick which ruptured the other end, no rupture is readily apparent, there being very minute ruptures at the base of every thread, thus demonstrating the complete uniformity of the fibrous structure.

Falls Hollow Staybolt Iron is made from double refined charcoal billets, and the long experience of the works in making this grade of iron as a specialty enables them to produce it in a very uniform quality, so that test samples really represent the whole amount in any shipment.

As is well known, the Falls Hollow Staybolt Iron has 3/16 in. holes clear through, so that the time and expense required for drilling every staybolt is avoided by the use of the hollow bolt. The use of the small hole in the staybolt is to detect fracture which almost always occurs near the outer sheet, and it is necessary, therefore, that the holes be kept open. A staybolt with the hole clear through will be kept open with certainty by the draught passing through it with every exhaust of the engine.

Care of Driving Boxes.

The papers which Mr. Donald R. Mac Bain has presented to railway clubs of late years and the reports which he has prepared for mechanical associations prove that he is a deep and thorough thinker on varied mechanical problems. A few paragraphs which appear in Mr. Mac Bain's book on "Locomotive Management" have struck us as being peculiarly worth the attention of enginemen and we have pleasure in reproducing them, as under:

"In the fitting up of driving boxes, wedges and shoes often lies the cause of serious failure in any, or one, of the following classes; hot driving journals, broken crank pins, and broken driving boxes, any of these are of enough importance to pay us for dwelling on the matter for a moment, and discussing the evils likely to lead up to such results. The trouble may be in any of the following defects; driving boxes rocking at the bottom or at the top, and poor bearings of the rubbing surfaces between box and wedge or shoes, as the case may be. In either of the first named defects we have a very annoying affair, to a good engine man, and the instrument of ultimate destruction to that box, either by breaking it, or loosening the brass, if allowed to run in that condition. In such cases engine men should make an effort to head off such defects by making an intelligent report of same to the people in charge at the earliest possible moment. If there is reason to believe that a box is 'rocking,' place the engine on 'quarter,' on that side, block the wheels on

opposite side, open the throttle and by reversing her a few times the defect can be located, and at the same time the extent of the 'rock,' whether one-thirty-second, one-sixteenth or one-eighth, should be noted so as to give the proper information to the men who do the repairs. This condition of boxes can be traced to two causes, one of which is the man who did the trueing and 'lining up,' of the wedges and shoes in the first place failing to be a good job, and the other, the fellow who packed the driving box when it got warm, while the engine was being 'broken in.' This fellow likes things to work easy, and when that cellar caused him a little trouble to get it out, he said to himself, 'I'll fix you before I put you in again,' and he does just what he said he would do, if there are no liners that he can take off the sides of the cellar he would just file enough off it so it will go in nice and easy thus allowing the bottom points of the box to come together, or collapse, as it were, after which the box will 'rock' at the bottom; in the case where the 'rock' is at the top it is safe to charge it up to the back shop man.

"The other bad condition, whose 'long suit' lies in causing boxes to heat, is where the bearing between the shoe or wedge and box is not full, i. e., when the box will bear of the wedge or shoe, and not on the outside, tight down on its whole depth on the inside. This condition is bad, as it does not afford a solid bearing for the box, when the engine is at work causing it to 'twist,' on the journal and also causing a great weight to be thrown on that part of the journal and brass immediately in line with that part of the box that has a bearing on the shoe or wedge, or, in other words, instead of the blow incidental to the working of the engine, being distributed over the whole surface of the wedge, it is concentrated on the small line of contact referred to above, and the work on the journal is in like manner concentrated on a very small surface, result; undue friction and hot bearings.

"To ascertain whether or not the box bears fully and evenly on the shoe or wedge, first put the wedge up tight, then place engine on quarter and get someone to reverse a few times, with the throttle open, and by watching the box from both in and outside, any defect in the bearing of the box on the shoe or wedge can be detected."

Horsepower Required to Drive Machine Tools.

Every intelligent mechanic is interested in the amount of power required to drive the various tools used in railway shops. It is little more than a century since the only machine tool used was the lathe, and it was a one-man tool, the power being provided by the operating machinist. As one horsepower, or 33,000 lbs., raised one foot per minute, is equivalent to the work of twelve men, the power of one man being 2,750 lbs. raised one foot per minute, it will be seen that all modern power driven machines represent immense man power.

When the lathe was first brought to Europe it was driven by means of a bow with the cord encircling a pulley on the head. In this process the tool cuts during one stroke of the bow and runs back during the other stroke. Lathes of that kind are still common in China and Japan.

The first radical improvement on the lathe was driving it by a crank, which produced continuous rotary motion. When this change was first introduced a lath pinned to the roof of the shop was connected with the belt that drew up the pedal, giving continuous motion. By degrees that lath gave the name to the tool, which was called a lathe.

Through the courtesy of the Niles-Bement Company, we are able to publish tables giving the horsepower required to drive the leading machine tools:

MILLING MACHINES, PLAIN AND UNIVERSAL.

Hor.	Range. Hor.	Vert.	H. P.
18 ins. x	6 ins. x	15 ins.	2
20 ins. x	7 ins. x	18 ins.	3
20 ins. x	7 ins. x	18 ins.	4
24 ins. x	7 ins. x	19 ins.	5
28 ins. x	8 ins. x	19 ins.	5
30 ins. x	9 ins. x	19 ins.	7½
34 ins. x	10 ins. x	20 ins.	10
50 ins. x	12 ins. x	21 ins.	15

RADIAL DRILLS.

Size.	H. P
3½ ft.	3
5 ft.	5
8 ft.	7½
10 ft.	10

VERTICAL DRILLS.

Dia. of Table.	H. P.
15 ins.	½
24 ins.	1½
26 ins.	2
40 ins.	3.4
60 ins.	5
96 ins.	7½

To Resharpen Old Files.

Wash the files in warm water to remove the grease and dirt, then wash in warm water and dry by heat. Put 1½ pints of warm water in a wooden vessel, put in the files, add 3 ounces of blue vitriol, finely powdered, and 3 ounces of borax. Mix well, and turn the files so that every one may come in contact with the mixture. Add 10½ ounces sulphuric acid and ½ ounce of vinegar. Remove the files after a short time, dry, rub with olive oil, wrap in porous paper. Coarse files should be kept in the mixture for a longer time than the fine ones.

Questions Answered

OVERTURNED LOCOMOTIVES.

189. E. McB. W., Oakland, Cal., writes: In the July number of your magazine, under "Questions Answered," you state that "several locomotives fell over during the earthquake in California." I should like to know where this occurred, as I was on a locomotive in Oakland yard when the great earthquake in 1906 took place. The shock was as severe here as anywhere and no locomotive fell over. A.—In May, 1906, at our special request, a number of leading railroad men in California sent us accounts of their experiences during the earthquake, among them Mr. E. A. Kelsey, employed on the Santa Cruz Line, advised us that one train of thirteen cars turned over while running on that line, and Mr. C. C. Stevens, of the North Shore Railroad, further related that locomotive No. 14 of that line and three cars fell over at Sausilita, Cal. Mr. Stevens' description was accompanied with a photograph showing the overturned train, which we reproduced in the June, 1906, issue of RAILWAY AND LOCOMOTIVE ENGINEERING. The illustration appears on page 270, and may be seen by any one having files of that year. Doubtless many believe that their particular location was the center of the shock, but the evidence showed that the vicinity of Santa Rosa, Cal., was the most violent in its vibrations. A mountain was shaken there, and a railway tunnel three-quarters of a mile in length fell in. Trees were uprooted and thrown upon the railway tracks, and rails were bent in the shape of the letter S.

EVAPORATION.

190. P. M. B., Belfast, Ireland, writes: I would like to have explained to my satisfaction how it occurs, that with a constant pressure and the feed water temperature used as high as is possible, a greater evaporation per pound of coal is not got. Thus, I quote the following from Barr: "Suppose a boiler to evaporate 9 lbs. of water per lb. of coal the feed water entering at 70 degs. F., the steam pressure to be 100 lbs., by gauge, what is the equivalent evaporation from and at 212 degs. F.—Ans. 10.683." At same pressure but temperature of feed water to be 170 degs. F., the equivalent evaporation from and at 212 degs. F. is 9.747, or a difference of .936 less than that quoted above. Although the feed water temperature is 100 degs. F. higher, is it not sound reasoning to imagine that 1 lb. of coal would evaporate a greater quantity of the higher heated water?—A. It would seem at the first glance that there should be a greater saving of fuel on account of the heated condition of the feed water, but if an

exact calculation of the large amount of water already in the boiler is made with the small amount that is being injected into the boiler, the slight amount of saving will become apparent. The best authorities agree that after repeated tests have been made, it has been clearly demonstrated that in the case of a boiler working at a gauge pressure of 150 lbs. per square inch, with the feed water supplied at a temperaure of 32 degs. F., then 1,193 thermal units of heat will have to be supplied per 1 lb. of water evaporated; but if the feed water be supplied at a temperature of 212 degs., then only 1,013 units of heat will be required per 1 lb. of water evaporated. This is a reduction in the amount of heat required, and means a saving of 15 per cent. Tests of this kind are costly, and it is safe to accept the established estimates of leading authorities published as being nearly correct.

DRIFTING.

191. R. C., Cairns, Que., asks: What action takes place in the steam chest with an ordinary balanced valve, when the engine is drifting, or running with steam shut off? Some say that owing to the admission of air through the relief valves, the valve floats, as it were. Others contend that it makes no difference, and that the weight of the valve keeps it down on the valve seat the same as an unbalanced valve.—A. The latter opinion is correct. The entire weight of the valve remains upon the valve seat. When steam is applied there is a greater weight on the valve because there is always a small portion of the valve unbalanced. If it were not for the relief valve air would be drawn in through the exhaust pipe carrying cinders and ashes into the cylinders, but the admission of air does not materially affect the action of the valve further than somewhat lightening its pressure upon the valve seat.

SPECIAL APPRENTICES.

192. J. W. K., Chicago, Ill., writes: We hear a good deal about special apprentices. Have they any special method of training that is applied to them other than the method in vogue in the shop where they are employed? Have they a preference of work and special training, or is it simply a case of their parents being people of means, and the special apprentice can come and go at his sweet will?—A. No. It is purely a question of previous education. All special apprentices, as far as we are aware, must be graduates of some technical school or college. There is no special privileges in the training or hours of labor, or remuneration. The only variation in the training course may be in the fact that while ordinary apprentices usually confine themselves to some special trade or branch of trade, many of the special apprentices spend a certain period in several trades or branches.

PATENT RIGHTS.

193. R. McR., Kingston, Pa., writes: When a patent is obtained on a new invention, and the patentee has been at considerable expense in complying with the law, is it not the duty of the government to protect the inventor from the infringements of unscrupulous individuals who evidently are actuated by a desire to grow fat on other men's brains?—A. No. It is the duty of the officials in the patent office department before issuing a patent to make inquiries as to whether a patent has been granted on any similar invention, and if such a discovery is made, to refuse a patent on such article. When a patent is once granted, the recipient must defend his rights in the courts, and if his claim is a just one,, the courts will sustain his claim.

CROSS-COUPLED AIR PIPES.

194. R. C. B., Brighton, Ala., writes: We have an engine equipped with the E. T. brake and when the automatic brake is applied, brake cannot be released with the independent valve, automatic valve being on lap, but can be released if automatic valve is in holding position. Would you tell me what is wrong?—A. As you could not exhaust the pressure from the application cylinder of the distributing valve when the equalizing valve was in lap position but could exhaust this pressure when the equalizing valve was in release position (as it would be with the brake valve in holding position) it indicates that the independent brake valve was exhausting pressure from the release pipe instead of the application cylinder pipe which would be due to cross-coupled or wrongly connected application cylinder and release pipes, that is, the release pipe would be connected to the distributing valve reservoir at the point the application cylinder pipe should be and the application cylinder pipe attached to the exhaust port of the equalizing slide valve.

The effects you mention could also occur if the application cylinder pipe should become closed and the release pipe leaking at the same time, but in this case the independent brake could not be applied and in holding position the brake would release from leakage instead of the movement of the independent valve.

DEFECTS OF BRAKE VALVE.

195. A. B., Youngstown, O., writes: What are the principal defects of the brake valve that will cause undesired quick action?—A. The principal defects of the brake valve that will contribute to undesired quick action are a sticky equalizing piston, a partly closed passage between the brake valve and equalizing reservoir, a reduced volume in the reservoir or an enlarged preliminary exhaust port.

While those disorders contribute to undesired quick action they are not absolutely sure to produce it, as for example, the preliminary exhaust port may be considerably enlarged yet the leakage past the equalizing piston ring may compensate for the additional volume that is escaping from the reservoir by reason of the enlarged port and the rate of reduction might remain the same as prescribed and thus the enlarged port would in no wise tend to reduce equalizing reservoir pressure too fast and tend to cause quick action.

SIZE OF BRAKE VALVE EXHAUST.

196. A. B., Youngstown, O., writes: What should be the size of the preliminary exhaust port in the H 6 brake valve?—A. 1/16 of an inch. This opening through the preliminary exhaust port bushing was originally 5/64 of an inch but it was found that in some conditions of high-pressure service, the 5/64 port tended to reduce equalizing reservoir pressure a trifle too fast or faster than the intended rate of reduction. This does not necessarily mean that all H 6 brake valves now in service should have the ports changed to 1/16 but if it is found that the rate of reduction is a trifle too fast the change may be made to advantage.

The equalizing reservoir volume should reduce from 110 lbs. to 90 lbs. in from 5½ to 6½ seconds when the brake valve is placed in service application position.

TIME OF APPLICATION.

197. F. A. M., Spencer, N. D., writes: What rate of leakage or rate of brake pipe reduction is necessary to cause an application of the distributing valve?—A. It depends entirely upon the condition of the valve. When the distributing valve is cleaned or repaired and tested on the standard rack, it must apply with the handle of the operating valve in the position No. 4, which gives a reduction of 15 lbs. in one minute.

When the valve is then used in service it is evident that like a triple valve, the amount of leakage necessary to cause the brake to apply depends upon the amount of friction and leakage developed.

PASSENGER CAR BRAKES.

198. J. B. I., Lakeland, Mich., writes: Why are some new steel passenger cars turned out with the high-speed brake equipment instead of the P. C., and what is the cost of P. C. equipment as compared with the high-speed? A.—As the P. C. is a comparatively new equipment, it is possible that the company purchasing the cars has not thoroughly investigated the improved features of the P. C. brake. As the price of this equipment is not as yet quoted in catalog form, we feel that it would be best to apply directly to the Westinghouse Air Brake Company.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances.

Published Monthly by

ANGUS SINCLAIR CO.

114 Liberty Street, New York.

Telephone, 746 Rector.

Cable Address, "Locong," N. Y.
Glasgow, "Locoauto."

Business Department:

ANGUS SINCLAIR, D. E., Prest. and Treas.
JAMES KENNEDY, Vice-Prest.
HARRY A. KENNEY, Secy. and Gen. Mgr.

Editorial Department:

ANGUS SINCLAIR, D. E., Editor.
JAMES KENNEDY, Managing Editor.
ALLEN G. WOOD, Consulting Engineer.
GEO. W. KIEHM, Associate Editor.
A. J. MANSON, Associate Editor.

Boston Representative:

S. I. CARPENTER, 643 Old South Building, Boston, Mass.

London Representative:

THE LOCOMOTIVE PUBLISHING CO., Ltd., 3 Amen Corner, Paternoster Row, London, E.C.

Glasgow Representative:

A. F. SINCLAIR, 15 Manor Road, Bellahouston, Glasgow.

SUBSCRIPTION PRICE

$2.00 per year, $1.00 for six months, postage paid in the United States, Canada and Mexico. For other parts of the world, $2.50, or ten shillings. Single copies, 20 cents. Remit by Express Money Order, Draft, Post Office Order or Registered Letter.

Mailing address can be changed as often as necessary—always give old and new address, and if you subscribe in a club, state the name of the agent.

Please give prompt notice when your paper fails to reach you regularly.

Entered at the Post Office, New York, as Second-class Mail Matter.

Traveling Engineers' Convention.

The Twentieth Annual Convention of the Traveling Engineers' Association will be held in the Hotel Sherman, Chicago, beginning on Tuesday, August 27, and continuing for four days. Secretary Thompson has displayed his usual vigor in stirring up the committees to get busy on the work of investigating the various subjects that will be reported upon, for we have already received five circulars of inquiry, each of them being very exhaustive. We trust that the members have done their part in answering the circulars, so that all information available may be put into the hands of the committees.

The Traveling Engineers' Association was organized in the office of LOCOMOTIVE ENGINEERING 20 years ago, its expressed purpose being "To improve the locomotive engine service of American railways." That purpose has been faithfully carried out, and it is only safe to say that the work done by this association has been second to none of the numerous organizations that are devoting their energies in promoting the interest of railway companies.

The Traveling Engineers' Association has of late years done much of the research work that was formerly done by the Railway Master Mechanics' Association, and it has been done very efficiently, for the members of the Traveling Engineers' Association come into much closer touch with locomotive operating problems than the master mechanics ever did.

In promoting the efficient operation of railway motive power, the traveling engineer has a great many duties to perform, some of them are pleasant and others are very disagreeable, and all of them are responsible. Be the duties pleasant or otherwise they are nearly always well done. As President Conger once remarked: "The good men in charge of engines must be encouraged, the in experienced instructed, and the indolent, careless ones notified as quickly and certainly as possible, that if they do not attend to their work nearly as well as the best, that they may expect to receive the spur of discipline. Mercy is sometimes thrown away on a lazy, careless man who mistakes mercy for want of detection.

When the Traveling Engineers' Association was formed it was by no means certain that such positions were permanent, not a few higher officials considering that railway companies could get along very well without traveling engineers, or road foremen of engines, as they are now popularly called. The forming of the association served in no small measure to bring the work done by its members into conspicuous light, and all that was needed to assure the popularity of the traveling engineer, was accurate information concerning the work he was doing. The traveling engineer rose in popularity among general managers and heads of the mechanical departments by proving that his work was reducing the expense of operating the motive power of American railways.

Cost of High-Speed Trains.

There is at present a pause in the discussion of the dangers connected with the running of high-speed trains, because winter is the season when accidents are most numerous, the season when heavy locomotives and overloaded cars transmit destructive blows to rails weakened or made brittle by frost and held rigid on congealed road beds, which act like anvils that render blows effective. Last winter provided many sad illustrations of the danger to travelers on high-speed trains; but the people interested do not seem to have learned the wisdom from the sad experience that would demand that the tendency toward reckless speed should be restrained. The spirit of competition is to blame for the running of high-speed trains and the people who use such trains gain remarkably little time from the velocity with which they have passed from city to city. If more publicity were given to explaining and analyzing the small gains of time secured from traveling on excessively fast trains, and the increased danger involved in that kind of transportation, we believe that fast running would become less popular. Fast running is a craze which ought to be restrained in every way, not only on railways, but on every line of transportation, from fast automobiles to fast steamers.

Railway managers have done remarkably little to restrain the taste for high-speed trains and we believe that is due to neglect in counting the cost. The most amazing ignorance prevails concerning the cost of moving trains at various speeds. People who have undertaken to figure out the cost of different speeds encounter so many items to be considered, that they generally give up the quest and fall back upon averages. Some years ago Mr. F. A. Delano made a thoroughly searching attempt to solve the problem: "What does it cost to run trains at high speed?" but the conclusions arrived at were by no means satisfactory. He grouped the cost of operation under the following headings:

First—Increased fuel consumption.

Second—Higher grade or standard of machinery, material and service required for the fast trains.

Third—Increased wear and tear, cost of maintenance machinery, permanent way, etc.

Fourth—Increased risk of accident by breakage of machinery, injury to track, etc.

Fifth—Increased risk of accident, such as collisions with other trains and delays incurred to avoid collisions.

Sixth—Delay to traffic on account of keeping the road clear.

The increase of fuel due to the accelerated speed of trains was ascertained with some approach to accuracy; but there was curious diversity of figures made out. Increased speed, from 30 miles an hour to 60 miles an hour, was taken as a basis of calculation and the amount of train resistance was reckoned to be doubled. One speaker had estimated that doubling the speed called for the consumption of about two and a half times more coal. Mr. F. H. Clark, now superintendent of machinery of the Baltimore & Ohio Railroad, made some exhaustive tests to find out the increased coal consumption due to increase of train

speed. He took into consideration for six months, the amount of fuel used, the wages of engine and train crews, and the cost of engine and roundhouse service, and found, so far as these items were concerned, that the cost per car mile was about 77 per cent. greater for a four-car train at 48 miles an hour than a seven-car train run at 31 1/3 miles per hour. Dr. Goss figured that increasing the train speed from 30 miles an hour to 60 miles an hour would involve an increase of 62½ per cent. in fuel consumption.

That part of the investigation did not involve great difficulties, for many railway officials have noted the fuel consumption required for various speeds both with passenger and freight trains; but finding out the cost involved in the other five items investigated by Mr. Delano, brought very little information and they all still remain subjects of mystery that well deserve the attention of members of our railway associations or railway clubs.

A statement was made concerning the fourth paragraph which would give some people new information about how a train collision at high speed is so much more destructive than a collision of trains running at moderate speed. The effect of a collision is in proportion to the square of the velocity. Now the difference between the work done by an engine going 30 miles an hour and an engine going 60 miles an hour can be put in this way: At 30 miles an hour the momentum of the engine or train is sufficient to raise it 30 feet vertically, and at 60 miles an hour the momentum would raise it 120 feet vertically. By considering the amount of destruction which would be done by dropping the train vertically 30 feet and 120 feet respectively, we will get an idea of the probable damage due to a collision at these speeds.

It is by no means creditable to railway companies that they have obtained so little information concerning the cost of fast trains, for finding out the extra cost of fuel is merely touching the beginning of a great business problem. The first move made by any manufacturing concern proposing to make any article to put upon the market is to find out what it costs. A great many railroad companies are moving trains at all sorts of speeds without paying the least attention to the cost.

Energy and Power.

Writers on engineering subjects very frequently fall into the mistake of using the terms energy and power as being synonymous; but there is a decided difference in the meaning of the words, although giving a clear idea of the relation of energy to power is difficult. We have so many young readers who are striving to learn the rudiments of engineering that we gladly publish an article from our book, Twentieth Century Locomotives, that seems to make the distinction between energy and power as plain as it can be made.

Although the terms energy and power are in continued use, such use is seldom in strict accordance with their scientific meaning. In many ways the conception of energy to power is difficult. This arises from the extreme generality of the terms, in any particular case the distinction is easy. It is easiest, says Prof. Reynolds, to express this distinction by an analogy; but as a matter of fact, everything that seems analogous is really on instance of energy. Power may be considered as directed energy; and we may liken many forms of energy to an excited mob, while the directed forms are likened to a disciplined army.

Energy in the form of heat is in the mob form, while energy in the form of a bent spring or a raised weight, matter moving in one direction, or of electricity, is in the army form. In the one case we can bring the whole effect to bear in any direction, while in the other case we can only bring a certain portion to bear, depending upon its concentration. Out of energy in the mob form we may extract a certain portion, depending on its intensity and surrounding circumstances, and it is only this portion which is available for mechanical operations.

Energy in what we call its natural sources has both these forms. All heat is in the mob form; hence all the energy of chemical separation, which can only be developed by combustion, is in the mob form, and this includes the energy stored in the medium of coal. The combustion of one pound of coal yields from ten to twelve million foot pounds of energy in the mob form of heat; under no circumstances existing at present can all this be directed, nor have we a right, as is often done, to call this the power of coal. What the exact possible power is we do not know, but probably about four-fifths of this, that is to say, from eight to ten million foot pounds of energy per pound of coal, is the extreme limit it can yield under the present conditions of temperature at the earth's surface.

But before this energy becomes power it must be directed. This direction is at present performed by the steam engine, which is the most reliable instrument art has yet devised, but its efficiency is limited by the fact that before the very intense mob energy of this is at all directed, it has to be allowed to pass into the less intense mob energy of hot water or steam.

The relative intensities of these energies are something like twenty-five to nine. The very first operation of the steam engine is to diminish the directable portion of the energy of the pound of coal from nine millions to three millions. In addition to this, there is necessary waste of directable energy, and a considerable expenditure of already directed energy in the necessary mechanical operations. In the very highest class of engines, the pound of coal yields about one and one-half million foot pounds. In the most efficient compound engines the pound of coal yields about one million, and in the majority of engines about five or six thousand foot pounds.

In the steam engine art is limited to its three million foot pounds per pound of coal; but gas engines have made a new departure, and there seems no reason why art should stop short of a large portion of the nine millions.

Deceptive Use of Good Books.

Judging from the number of complaints which we have received from alleged victims of deception, we are afraid that an excellent book has been pushed into the hands of railway train men and others through gross misrepresentation of its contents and its educational scope. "The Science of Railways" is an exhaustive work, consisting of twelve volumes that deal with such subjects as Organization, Financing, Fiscal Affairs, Origin and Evolution of Transportation, Freight Business and Affairs, etc. Only one of the volumes, called "Engineers and Firemen's Manual," contains matter that is likely to instruct enginemen on details of their business, yet thousands of trainmen have been prevailed upon to undertake the purchase of these books on the installment plan by giving orders upon their pay.

There are a great many institutions that undertake to impart instruction to people connected with the mechanical department of railways and most of them render a fair return upon the investment made, but the concern publishing "The Science of Railways" is an exception. To an ambitious man who is making his way to the top of the railway ladder and is likely to reach the position of general manager "The Science of Railways" will constitute a profitable study, but for a fireman, a machinist or a brakeman, the books would form a dreary wilderness of meaningless words.

There are railway officials accused of having used their influence to induce men of lower degree to spend their hard earned money upon the purchase of "The Science of Railways." The story is told of a criminal in Italy who was permitted to choose between the reading of a tremendously formidable history and working in the galleys. He choose Guicciardini's history; but the details of the War of Pisa proved too tedious and he begged to be sent to pull the oar. The worst punishment we would inflict upon the officials who imposed the "The Science of Railways" upon poor

enginemen is, that they should be compelled to read every word of the twelve volumes.

Knowledge and Skill.

We frequently receive requests for books that will teach men how to perform machine shop work, such as the reducing of rod brasses and the facing of valves. No book can teach that work any more than books can teach a person how to play the fiddle or to make cannon shots with billiard balls. "Chordal," in one of his famous letters, says: "In handiwork there are two elements, skill and knowledge of skill. Thus, in handturning, the knowledge of skill tells us that a certain kind of chattering proceeds from a certain peculiar handling of the tool. Skill shifts the tool around properly and the chattering stops. Probably the exercise of skill in holding the tool properly cannot be described, and if it could, he who was the most skillful would probably be the most or the least adapted to describe it. You see a man filing something roundedly, you take his file and file it flat. He asks you how you did it; you answer that you do it, but do not know how you do it. I do not believe that any man knows how he files flat. There are lots of things the skillful do which have no 'how' or 'wherefore' to them that can be got out of them.

"The witness on the stand said, 'I know it to be so', and the attorney, on cross-examination, said, 'On your oath, how do you know it to be so?' And the witness said, 'On my oath, I do not know how I know it to be so.'

"A man may know lots of things without knowing anything about how he knows them. There are many elements of manual skill, only a portion of which may be stated in descriptive terms.

"When a man wants to learn draughting, the first thing he begins to inquire about is some book out of which to learn draughting. When some other man wants to learn draughting, he goes at it and draughts, and the going at it and the keeping at it constitutes the learning. All the books under heaven will not stuff a man so full of knowledge that he can say that he is a draughtsman before he has commenced to draw. If it was a question of books, all he would need to do would be to acquire all the knowledge that is in them. I am a sort of a draughtsman myself, and I am aware that books on draughting should be read only by draughtsmen and not by people who wish to become draughtsmen. These books should be entitled, not, 'Information for People Desiring to Learn to Draw,' but 'Information for Draughtsmen.'

"In my opinion, the art of draughting is one of those things which, so far as the art itself is concerned, that is, the skill of it and the practice of it, will force themselves upon a person. He will draw in spite of himself; if there is any earthly necessity for his drawing, if the necessity and the honest desire arise, he will draw, and draw, and draw. He becomes a draughtsman, may be a good one, may be a poor one, and the books will do him good in either case. He needs them to initiate himself as a draughtsman. I draw a broad distinction between the geometry of the art and the art itself, between the perfectly drawn line and a comprehension of what the line means. He who is up in the science of lines and figures and bodies is a scientific draughtsman, but he is no more a draughtsman than he who knows nothing of them. The skill to delineate the creeping spider or the ugly lathe leg has nothing whatever to do with the laws of natural history, or the laws of the strength of material. A draughtsman may be more useful from a knowledge of the strength and material, precisely as he may be more useful by reason of being versed in natural history. When I speak of the art of draughting, I mean the art, pure and simple, of delineation, not of design or mechanical analysis, or of comprehension of the thing delineated."

Legal to Join Unions.

There has always been a sentiment against the practice of blacklisting the names of men discharged for the purpose of preventing them from obtaining employment, but still the practice has been followed by some officials who considered themselves superior to the law, but blacklisting is getting rooted out as well as the sentiment that sought to prevent workmen from joining unions.

A recent case is that of A. R. Hedges, who was employed as a switchman on the St. Louis & San Francisco Railway, and was discharged by Superintendent Coppage because he was a member of the Switchmen's Brotherhood and refused to abandon the organization.

The attorney-general of Kansas brought a criminal suit against Coppage for discharging Hedges. In the lower court Coppage was found guilty of violating the Kansas coercion law, which prohibits employers from discharging men because they are members of unions. Coppage was fined and appealed to the Supreme Court. The highest court in the State held that the fine imposed by the lower court should stand.

In the suit against Alfred Ackenhausen, from Leavenworth County, the same questions were involved, and the Supreme Court ordered a trial of the case in the district court, which had thrown out the suit brought by the State.

Learning Trades in Scotland.

In European countries it used to be the practice to subject youths learning a trade to a seven-year course of apprenticeship, which was an imposition upon labor, for the skill necessary was generally acquired in three years and the employers enjoyed the labor of the workmen for four years on small pay. The system kept up gross injustice, as it has been under dissolution for many years. The result is that in some trades where apprenticeship has been restricted, skilled workmen are becoming scarce. Connected with this subject the United States Consul in Edinburgh, Scotland, says:

"The breaking up of the apprenticeship system has forced upon the public authorities the problem of how to give boys a chance in life by affording them practical instruction in trades. For several years the Edinburgh School Board has provided, in connection with 27 separate public schools with 10,538 pupils, night instruction to classes in stenography, typewriting and in certain handicrafts—cabinet-making, upholstering and plumbing. In some of the night classes 98 per cent. of the day pupils are in attendance.

"A noteworthy development of this educational policy is the recent opening by the board of supplementary schools and large workshops for the trade instruction, where boys will receive thorough training in evening classes at the public expense. The new buildings comprise ten workshops, equipped with the requisite tools and appliances for the following trade classes: Cabinet-making, carpentry and joinery, plumbing, tinsmiths' work, engineering, brass finishing, moulders' work, pattern making, tailoring, upholstering, French polishing and plasterwork; and there are also rooms fitted for cookery and laundry work. The site of 3½ acres cost $37,435, the buildings $29,200, and the equipment $9,830.

"It is the intention of the board ultimately to give day instruction also during ordinary school hours, allowing boys at the age of 14 to 16 to enter the school workshop and receive instruction for two afternoons a week. At the end of the term there will be available the reports of the teachers and the inspector as to whether or not a boy has any aptitude for the particular craft or trade in which he has been engaged. If the report be favorable, the time devoted to technical instruction will be extended.

"If convinced of the great advantage of such training, parents, it is believed, will be willing to allow their boys to remain at the school for another year, while they are looking for situations."

The Narrow Gauge Fallacy.

One of the most absurd engineering policies ever promoted by some sensible men was the movement to construct narrow gauge railways for the transportation of ordinary traffic. Some forty years ago when sensible railway men were begin-

ning to perceive that railway companies had made a mistake in adopting the 4 ft. 8½ ins. gauge instead of the 5 ft. or 6 ft. gauge, a set of misguided men organized a movement in favor of building railways of even narrower gauge than the standard. They presented the argument that narrow gauge railways could be made and maintained at lower expense than could the standard gauge, so the movement in favor of producing narrow gauge railways grew and flourished for a few years. It did not need much practical experience to prove that a narrow gauge railway was worked as wastefully as a man working at coal heaving with a narrow gauge shovel.

The Denver & Rio Grande, with gauge of 3 ft., was the longest narrow gauge railway in the United States. It is being gradually changed to the standard width. A recent newspaper announcement reads: "The directors of the Denver & Rio Grande Railroad Company have authorized the conversion of the narrow gauge line between Salida and Montrose, over the Marshall Pass, into standard gauge, a distance of 136 miles of main line and 27 miles of branch line. The board also appropriated $100,000 for ballasting and $150,000 for additional side and yard tracks. With the standardizing of this line, which will be completed within six or eight months, the Denver & Rio Grande will have a double track standard gauge line practically across Colorado."

Engineers as Witnesses.

Much interesting testimony has been presented to the Arbitration Commission on the question of an increase of the remuneration to locomotive engineers. The evidence given by the engineers themselves has commended itself to the press and public. Witnesses not accustomed to court procedures and the presence of legal and other luminaries are not infrequently awed into stupefaction, and act and speak in a manner quite at variance with their real characters. None of this weakness has been displayed by the engineers. Men who spend their strenuous daily life in handling the titanic forces of nature harnessed in complex equipment, and meeting and observing all sorts and conditions of people, are not easily disturbed. They are men of action, and may be relied upon to give a good account of themselves under any emergency. Their answers were prompt and illuminating, with an individuality that gave a relish to their vivid descriptions of the details of their calling. It was Cicero that said that we are all eloquent in the things that we know. This is true in a sense, but it depends much on the kind of audience which we are attempting to enlighten whether our eloquence will blossom into fullness or sink into dullness. The engineers were never dull, and whatever the outcome of the Commission's work may be the investigation has aided in bringing into prominent notice the sterling qualities of railroad men.

Among other evidence it is a matter much commented upon by the press that the engineers examined were of opinion that the risk of death and the strain of their work were both increased by the translation from steam to electric power. They asserted, for one thing, that in case of a collision the engine driver is in the very front, just behind the glass window, and has no chance to escape, even though the train as a whole is little damaged. Any slight obstruction, such as the branch of a tree, would break the glass and cut and injure the driver with his face a few inches behind the window.

There is also great danger of being shocked or burned, it was testified. Many firemen get shocks through oil cans or tools while working about the electric motors.

All the eight drivers on the stand were of the opinion that the electric engines were harder to handle, especially the one factor of having continually to hold down the controller, which requires a force of four pounds. If the driver for an instant relinquishes his hold, the controller flies up, the emergency brakes are set and the train comes to a stop with a jolt.

J. G. Garland, of the New Haven road, said a permanent bulletin warned the men to keep at least fourteen inches from the wires carrying the current.

T. J. Kelleher, of the Pennsylvania system, declared he had been shocked several times and has been assigned back to steam at his own request.

Dead Weight Per Passenger Carried.

When steel passenger cars began to come into use objections were raised that they would increase the amount of dead weight in proportion to the paying load. This is not correct. When iron ships first were tried it was feared that the dead weight would make their use unprofitable, but it was found that they floated lighter than wooden vessels of equal capacity. The same thing has been found with steel cars. They are lighter than wooden cars of equal capacity.

Electric suburban cars carry more passengers for the dead weight than any other railways, but there is from 750 to 1,750 pounds of car hauled for each passenger carried. In steam railway operation the dead weight is three times the weight of the paying freight. In passenger business, it requires four to five tons for each passenger carried. The dead weight for sleepers and parlor cars is much greater.

Railroad Wages.

The New York *Commercial* states that now that the dispute between the Brotherhood of Locomotive Engineers and the 52 railroad companies of the Eastern district has been submitted to arbitration, a comparison of wages paid here and abroad to railroad employees becomes of interest in considering the rights of the parties involved. The highest wages paid in Europe are those received by railroad employees in Great Britain.

Railroad employees in the United States were paid an average daily wage of $2.23 in 1910, the latest year for which statistics are available, as compared with $1.05 in the United Kingdom, 81 cents in Prussia, 89 cents in Austria, and from two to three times as much as in Italy. The latest official returns available for continental Europe are those of 1908. In that year locomotive drivers were paid $647 a year in Germany and $870 in Austria. Firemen received $424 in Germany and $532 in Austria. The annual pay of locomotive drivers on two of the principal railways of France ranged in 1908 from $505.66 to $906.91, and of firemen from $324.24 to $595.98. In Italy enginemen received in 1908, salary and allowances included, from $581.10 to $812.70 a year; firemen, from $330.30 to $475.05 a year. In these continental countries the maximum compensation is received only after many years of service.

The average annual compensation of enginemen in the United States in 1908, on an estimated basis of 300 days' service, was $1,335; of firemen, $792. In this country the rate of compensation to these employees does not depend on length of service.

Rents actually paid in the United States by railroad employees are considerably higher than abroad, but the accommodations secured are infinitely superior in every respect. As far as the retail cost of food and fuel is concerned, the cost of living in the United States is reported in Washington estimates to be 17.8 per cent. higher than in Germany, 35.3 per cent. higher than in Belgium and 38 per cent. higher than in Great Britain. These figures are arrived at by taking the English standard of living as a basis of comparison.

Important Business.

Apart from the increased business on railways, the increase in life insurance is a certain indication of improved conditions.

"The volume of new insurance reflects the attitude of the business men of the country toward the political campaign," said Mr. Appel, vice-president of the New England Life Insurance Company. "The business men of the country are satisfied there will be a revision of the tariff and a revamping of the Sherman anti-trust law into an intelligible and workable statute, and conditions are bound to improve."

Catechism of Railroad Operation

By Angus Sinclair

Questions and Answers.
Second Series.

(*Continued from page 177.*)

194. What are the certain indications that a locomotive is getting run down or falling into inferior condition?—A. The fact of steam blowing through valves, pistons or joints and pounding or rattling of the working parts.

195. What is the most common cause for locomotive pounding?—A. Wear or defects of driving axle boxes and in the connection of rods.

196. How can the cause of such pounding be located?—A. Place the engine on the top quarter and having the driving wheels blocked. Direct the fireman to admit a little steam to the cylinders and move the reverse lever to and fro from front to back gear. When this is done with both sides of the engine, the engineer keeping a keen watch is likely to detect the cause of trouble, be it in boxes or rods.

197. What defects are most likely to cause pounding in rods?—A. A loose key or a badly worn brass.

198. What causes driving boxes to pound?—A. Worn brass, improperly fitted shoes and wedges or defective adjustment of the shoes and wedges.

199. What is the principal cause of wedges being badly adjusted?—A. It frequently happens that an engineer notices that a box is pounding and he takes the opportunity of moving up the wedge when lying in a side track without giving the others any attention. This throws the drivers out of tram and leads to a variety of disorders, among them bent crank pins and sometimes broken side rods.

200. What is meant by the expression "out of tram"?—A. When a locomotive is properly built the centers of the axles on one side coincide exactly with the centers of the wheels on the other side; and the distance between the centers of the crank pins to which the rods are secured is the same on both sides. Measuring these distances is done by a tram or trammel, hence the expression, being in tram. When the connections are out of tram they move over the centers by straining the mechanism.

201. May dangerous strains be imparted to side rod crank pins that are adjusted in tram?—A. As the wear on a crank pin is greatest at the points where the pin is on the top and bottom quarter that forms the smallest diameter of the pin. If the brasses are adjusted snug on that point there will be jarring and pounding when the brass tries to pass over the greatest diameter.

202. Are there any other causes of pounding besides that caused by rods and axle boxes.—A. Some of the most alarming pounds are inside the cylinders. The worst pound that the writer ever encountered was a loose piston head.

203. How could you locate which side a loose piston head was on?—A. The pound happens when the cylinder is taking steam unless the piston is loose enough to strike the cylinder head. By walking alongside the cylinder when the engine is moving slowly the defective side will be easily identified.

204. What must be done with a loose piston-head?—A. It must be removed and the ports covered.

205. What other piston defects cause pounds?—A. Loose follower bolts or the piston rod loose in the cross-head.

206. How can such defects be located? —A. Loose follower bolts can be identified in the same way as a loose piston head. It is generally possible to tighten loose follower bolts by removing the cylinder head. A piston rod loose in the cross-head can generally be secured by driving in the key. If a follower bolt is striking the cylinder head and cannot be tightened it must be removed.

207. Is there any other cause of pounding inside the cylinder? A. Sometimes when machinists have been working on the main rod connection, they make mistakes in locating the movement of the piston. It may be that the main rod connection is made too long, which will cause the piston to strike the front cylinder head; in other cases the connections may be left too short, in which case the piston will strike the back head. In either case the knock will sound when the crank pin is passing the center.

208. At what time is pounding of a locomotive likely to be most noticeable?—A. When the engine is starting a train.

209. Are knocks likely to be about the same intensity on both sides of the engine?—A. No. Pounding is nearly always more on the left hand side than on the right hand side, when the engine is running forward, and it is worst on the right hand side when the engine is running backwards. That is with locomotives having the right hand crank leading.

210. What is the explanation usually given of pounding being worst on the side on which the crank is following?—A. Fowler-Wood on Locomotive Breakdowns gives the following explanation, which is well reasoned out: "This is due to the relative position of the cranks The cranks are set on the quarters with the right hand one usually leading when the engine is running ahead. Following the course of the steam distribution for a revolution will make the action clear. When the right hand crank passes the back center, its cylinder takes steam at the back end and the driving box is pressed against the forward edge. This continues until the top quarter is reached, when the same thing takes place on the left hand side. Soon afterwards the exhaust is opened on the right hand side and there is no further pressure in the cylinder to hold the box against the front leg of the pedestal and the box is forced to move back. This it does under the influence of the steam pressure in the left hand cylinder. This pressure tends to draw the left crank pin ahead, and so the axle turning on the left hand box as a fulcrum is thrown back on the right hand side and that box is moved against the rear pedestal with a comparatively light pound, owing to the distance between the boxes being so much greater than that from the left hand box to the crank pin. This puts the right hand box in a position to take the thrust of the steam when the crank passes the forward center, and no pound takes place at that time. The exhaust then opens on the left hand side with the box against the forward wedge, where it is held by the steam pressure upon the right hand side, tending to thrust that end of the axle to the rear, while the left end is held to the front with the box. This continues until the left crank passes its forward center, when the admission of steam to the front end of its cylinder thrusts it, with its box, violently to the rear and there is a heavy pound as the latter strikes the wedge."

211. What are the best precautions to be made for preventing the pounding of axle boxes?—A. Keeping the wedges up so snugly that very little lost motion is left between wedge and box.

212. In case your engine met with an accident that required its being put upon the dead center, how would you proceed?—A. Have the engine moved slowly while I watched the movements of the cross head. When it stopped moving at the end of its travel I would call that the dead center.

Railway Signaling

After having described in the two preceding articles the two main divisions of signaling, and shown by illustrations the practices described, we can come to the important subjects of the delivery of orders, and the proper protection of trains against possible obstructions, among which are misplaced switches and other errors.

The delivery of orders in the past has been handled almost exclusively by stop signals, no provision having been made for a specific signal to be used when 19 orders were to be delivered. The treatment of the delivery of 31 orders is correct, because the trains must stop to enable the trainmen to properly acknowledge the orders, but when 19 orders have to be delivered there is no necessity for trains to stop, and some other treatment seems to be advisable. Up to the time the whole subject was discussed in the associations, nothing had been done and it was customary to display a stop signal. As the engineman approached the signal he would receive the orders and so obtain the necessary clearance of the stop signal. As the conductor passed he would receive the same authority and so the transaction was completed.

Where the manual block has been instituted in territory where orders are issued the same signal has been used for both purposes. This has been criticized by many earnest thinkers, because they claim there should be specific signals for each purpose.

There have been several things in the nature of construction which have been thought of sufficient importance to signal against. So-called misplaced switches and trains discharging passengers at stations on double tracks are among the things which have been considered.

These have been treated in different ways. Switches set for sidings or junctions have in some instances been protected by stop signals some distance from them, which could be flagged by if indicating stop. In others caution signals of the same general character as the distant signals used at interlocking plants have been installed. The latter practice seems to be more correct, although, if the distant signal is always to be associated with a home signal, even this treatment does not appear to be perfect.

For protection against the discharge of passengers some new type of signal has been provided, as a rule. This, in some instances, consists of a blue disc by day and a blue light by night, the absence of a disc or a white light indicating that no train is discharging passengers. Other forms were tried, but all of them tended to be of distinct form. It would seem that any signal which would indicate that the speed of the train must be limited would serve the purpose.

The condition of signaling before a thorough discussion was given the subject has now been described, and it will be noticed that, while three-position signaling was considered and used by a few roads, the majority of roads still retained the two-position signal. This led to many complications, although no serious accident can be recorded because of its use. For the benefit of our readers, however, who are accustomed to simple signaling, a few of the combinations used on four and six-track roads are given below.

All these combinations actually existed, and many others were added owing to the thought which had begun to enter into signaling that specific information should be given by signals used for different purposes. In an effort to simplify the situation, during the years 1903 to 1905, committees of the Pennsylvania Lines, east and west, and of the New York Central Lines, held many meetings and finally a report was made by the Pennsylvania Railroad, which, of course, was not published. Various partial reports were made to the Signal Association, but the first real start was made by a big committee of this and the American Railway Engineering Association in 1906. At this meeting the following was adopted as a basis:

A system of fixed signal indications may be based on either of two assumptions:

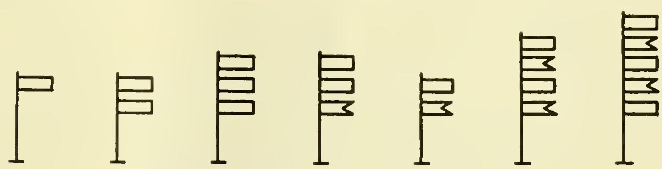
1. That signals should indicate to the engineman what is required of him in the control of his train and also the reason for the required action.

2. That the engineman needs to know only what is required in the control of his train.

Since the purpose of signals is to give to the engineman of moving trains information or instructions that must be acted upon without hesitating, it is plain that the indications of the signals and the means of giving them must be such that the meaning can be grasped instantly without conscious study or effort. It is taken to be self-evident that, as the number of instructions conveyed by the signal aspects increases, it becomes increasingly difficult for the engineman to remember the meaning of the aspects used, especially any that are not often met with in his daily routine, and the chance of wrong reading increases. In addition the practical difficulties in the way of displaying a large number of distinct aspects must be taken into account. Tested by these considerations, the first assumption is found to require too many aspects.

While it is assumed that the engineman must be fully acquainted with the unchanging physical characteristics and the running rules of the road or portions of the road over which he runs, including locations of fixed signals, it is realized that the engineman's mind should be relieved as far as possible from the necessity of remembering what each signal is for; and plainly this can be done only by giving more indications than would be required in a system based strictly upon the second assumption.

It is, therefore, the conclusion of the committee that, in a system of signal indications, the aspects should primarily serve to indicate what is required of the engineman in the control of his train, and secondarily, should provide for the giving of certain additional useful information, limited by the reasonable practicability of displaying the necessary aspects and the added burden upon the engineman's memory that will result from the use of many aspects.



SOME COMBINATIONS USED ON FOUR AND SIX TRACKS.

Previous to this meeting a great deal of preliminary work had been done to determine what special signal should be used as a basis for the system. There have been presented in previous articles a number of different signals, but all had objections. The two-position signals, such as shown in Figs. 11 to 13, were objected to because the caution indication had to be given by the horizontal position of a peculiarly shaped blade, and the three-position signals shown in Figs. 10 to 15 were objected to because the vertical position of the blade pointing downward was not easily read on account of being parallel with the signal mast.

Air Brake Department

Equipoise in Forces.

Judging from some inquiries concerning the article entitled "Requisite Braking Power," which appeared in the July issue, it appears that an equation embracing the accelerating and retarding forces in effect upon a car descending a grade with the brake applied, could have been made somewhat clearer had the example been worked out in multiplication and division of car weight and braking power.

For the benefit of many of our readers who do not follow air brake matters as closely as they might or who cannot spare the time to work out problems of this nature, we will again refer to this subject of braking power required to equal the accelerating force of a car when descending a grade.

Evidently the misunderstanding occurs as the car weight is dropped out and the equation transposed, and the following will be an effort to set forth the problem and work out the answer without the necessity for any mathematical calculation upon the part of the reader unless he wishes to check up the results.

While reflecting upon the calculation the writer recalls an occurrence, or rather part of a conversation, of some years ago, upon the subject of braking power in which he referred to the difference between 90 per cent. braking power and car weight, as "unbraked weight," whereupon an air brake expert said: "You did not attempt, or else failed in an analysis of that last statement. If you were to break that car up into 1-lb. pieces you would find that for every pound in weight there is 9/10 of one pound braking power."

After the problem is stated, before considering a car or a train of cars, let us begin with one wheel and proceed until the equation referred to is reached.

The car in question weighed 40,000 lbs., was braked at 60 per cent. of its weight, based upon 50 lbs. cylinder pressure, and was supposed to be descending a 2 per cent. grade. We wish to know the per cent. of braking power required to equal the accelerating force down the grade, that is, the braking force that will not permit either an increase or decrease in the speed of the car.

The average co-efficiency of friction obtained under the assumed condition is about 10 per cent., and the brake rigging efficiency of the freight car averages about 95 per cent., and before considering this any further let us note, for a time, the forces in effect upon revolving car wheel when a brake shoe is applied. Imagine the wheel traveling along the rail at a speed of 60 miles per hour and the weight holding the wheel to the rail to be 5,000 lbs., which it will be in the case of a 40,000 lb. freight car, and braked at 60 per cent., based on 50 lbs. cylinder pressure, will give 3,000 lbs. brake shoe pressure as a result of a full service application of the brake.

The actual pull of the shoe on the wheel tending to check the rotation is derived from the force pressing the shoe against the wheel and is termed the co-efficient of friction, and the adhesion of the wheel to the rail or the friction or holding power of the wheel on the rail is frequently referred to as the co-efficient of adhesion.

To observe an air brake stop from a 60-mile per hour speed in 1,100 or 1,200 ft. and then imagine the length of the stop if the wheel flanges were chipped off and the same stop attempted on a lake covered with ice thick enough to sustain the weight of the train, will give a fair idea of the part played by the wheel adhesion during the stop.

Under ordinary conditions this holding power or co-efficient of adhesion ranges from 15 per cent. to 30 per cent. of the weight of the wheel on the rail and varies only with the condition of the rail or surfaces in contact. The use of sand or similar substance would increase the percentage of adhesion while the use of a lubricant would lower the friction or adhesion and the average co-efficient of adhesion equals, or is, about 20 per cent. of the weight pressing the wheel to the rail.

By referring to the results of the brake tests conducted by Mr. George Westinghouse and Captain Douglas Galton in 1878, which are, by the way, considered an authority even at the present day, we find that at a speed of 60 miles per hour a force on the brake shoe equal to 2.77 times the weight of the wheel on the rail was required to check the rotation or slide of the wheel when the co-efficient of adhesion was 20 per cent.

We have assumed a wheel to be resting on a rail with a weight of 5,000 lbs. and revolving at a rate that a point on the periphery reaches a speed of 60 miles per hour, then under a condition of rail that permits of a 20 per cent. adhesion, the brake shoe pressure necessary to slide the wheel is 5,000 lbs. $\times$ 2.77 or 13,850 lbs.

The adhesion of the wheel to the rail is 20 per cent. of 5,000 lbs., or 1,000 lbs., hence the co-efficient of friction is 1,000 $\div$ 13,850 or .072, or a shoe pressed against the wheel with a force of 13,850 lbs. produces a pull on the wheel that equals 1,000 lbs., therefore the co-efficient of friction must be .072.

It will occur to the reader that at 60 miles per hour the braking power necessary to result in wheel sliding is not 60 per cent., 90 per cent. or 130 per cent., but 2.77 times 100 per cent. or 277 per cent.

The object of the foregoing is to prove that under these conditions the co-efficient of adhesion obtained between the wheel and rail, 1,000 lbs. $\div$ .072, or more exactly .0722, the co-efficient of friction equals 13,850 lbs., the brake shoe pressure necessary to equal the force effective between the wheel and rail.

To revert to the equation referred to,

Car weight	= 40,000 lbs.
Braking power	= 24,000 lbs.
Per cent. of grade	= .02
Per cent of braking power	= .60
Co-efficient of friction	= .10
Brake rigging efficiency	= .95

The article we have referred to states why per cent. of grade $\times$ weight of car = accelerating force due to grade, then 40,000 lbs. $\times$ .02 = 800 lbs.

On the other hand, per cent. of braking power $\times$ co-efficient of friction $\times$ brake rigging efficiency = retardation in per cent. of car weight, hence .60 $\times$ .10 $\times$ .95 = .057 or 5.7 per cent., and 40,000 lbs. $\times$ .057 = 2,280 lbs., the actual force of retardation assuming a 60 per cent. braking power in effect.

In this case, however, the per cent. of braking power is known, but we wish to find the per cent. of braking power that will equal the accelerating force and as the calculation of the forces in effect upon the revolving car wheel shows that the force tending to keep the wheel rotating divided by the co-efficient of friction obtained gives the braking force required to stop the rotation of the wheel or the braking force that will equal the accelerating force, hence accelerating force due to grade divided by car weight multiplied by co-efficient of friction and brake rigging efficiency equals per cent. of braking power required or per cent. of braking

$$\text{power} = \frac{40{,}000 \times .02}{40{,}000 \times .10 \times .95}.$$

40,000 $\times$ .02 = 800 lbs.

40,000 $\times$ .10 $\times$ .95 = 3,800 lbs.

800 $\div$ 3,800 = .21 or 21 per cent braking power is necessary to prevent an increase in speed.

To prove the figures,

$$40{,}000 \times .02 = 800 \text{ lbs.}$$

$$= \begin{cases} 40{,}000 \times .2105 = 8{,}420 \text{ lbs.} \\ 8{,}420 \times .10 = 842 \text{ lbs.} \\ 842 \times .95 = 800 \text{ lbs.} \end{cases}$$

Our object in making this rather lengthy explanation is for the sole purpose of presenting this method of finding the required braking power in a way that will be apparent to every reader of the air brake department, and if everyone interested in the article on "Requisite Braking Power" will carefully read this article before requesting an explanation we will be amply repaid for the time expended in the preparation. The results have been proved by careful calculation and may be relied upon as correct.

It will be noted that there is no difference whatever in results, but the equation in connection with the former article shortens the calculation in that the common multiplier, car weight, is dropped and the equation transposed as follows:

The unknown quantity P, or braking power, required is per cent. of grade ÷ by co-efficient of friction × by brake rigging efficiency, which is expressed

$$P = \frac{.02}{.10 \times .95} \text{ or } .02 \div .095 = .21 \text{ or}$$

21 per cent. braking power is required.

Empty and Load Brake.

Last month's issue contained a view of the foundation arrangement of the "empty and load" freight car brake and this issue contains two views of the operating valves.

The larger cut of valves, reservoirs and brake cylinders complete, shows the K-2-K triple valve which supersedes the K-2-H for this equipment and the triple valve piston and slide valve is in normal release and charging position with the cut-out piston and slide valve in what is termed "empty" position, all ports, passages and their connections are shown, while in the smaller cut the triple valve piston and slide valve are in the same position, but the cut-out piston and slide valve are in "load" position, meaning that the "load" brake is cut in and only the ports and passages used in this particular position are shown.

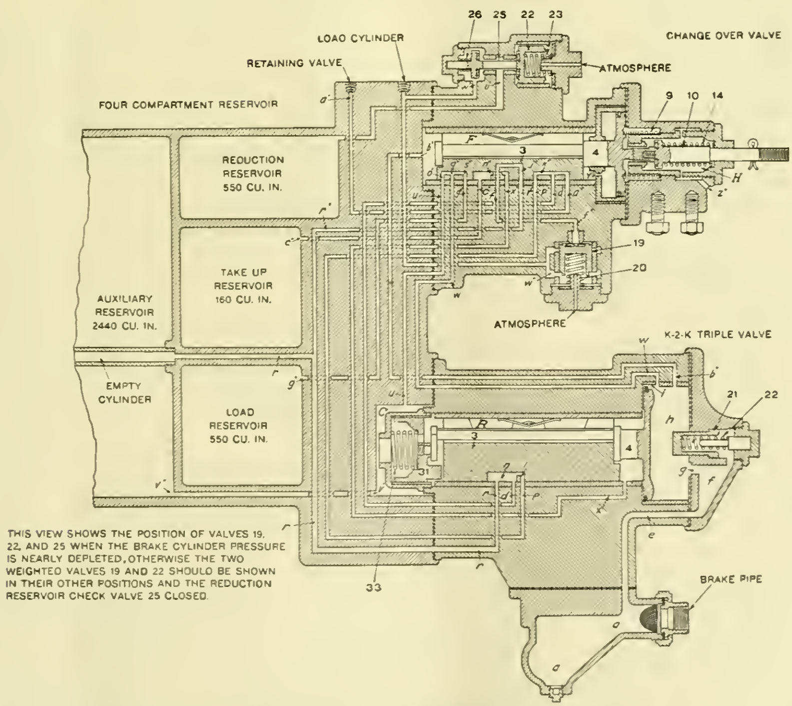
Next month's issue will show the valves in retarded or restricted release, quick service, full service, and emergency positions and each cut will show only the posts used at that time, thus the flow of air can be as readily and accurately traced as in the views of the "passenger control" equipment which were shown when this brake was described, but before attempting to trace any flow of air it is necessary to give a general description and state the objects and duties of the parts if a thoroughly comprehensive description is desired.

We have stated that the brake must, and does work, in harmony with any other type of automatic air brake and when in "empty" position (which is for use when the car is empty) the "empty" brake cylinder operates with the same volume and pressure as the present standard equipment, piston travel being the same.

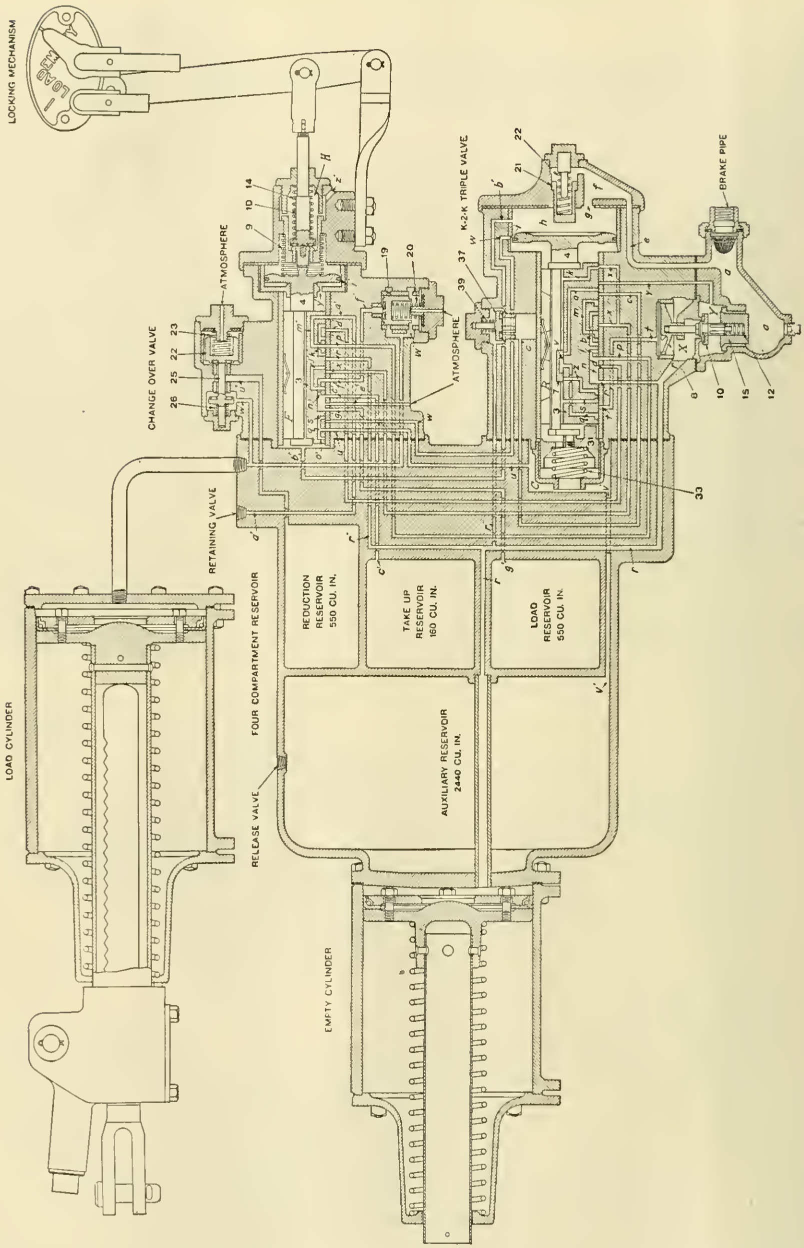
When the car is loaded and the brake is cut into "load" position the empty cylinder operates alone up to the time the use of the second, or load cylinder becomes necessary. This time is predetermined and governed by the pressure obtained in the empty cylinder.

The supply of compressed air for operating the "empty" cylinder is stored in the largest chamber, of the four compartment reservoir, the capacity of which is 2,440 cu. ins. of compressed air.

The triple valve which is of the well-known K type has quick service, uniform recharge and restricted release and while there are a number of additional port openings controlled by the slide valve which do not give any operation save in load position, the triple valve does the



EMPTY AND LOAD EQUIPMENT WITH FOUR COMPRESSOR RESERVOIRS. NORMAL RELEASE AND CHANGING POSITION. CHANGE AND VALVE IN LOAD POSITION.



EMPTY AND LOAD EQUIPMENT. RELEASE POSITION.

same work of any other K triple valve when working with the cut-out valve in empty position and when in load position provision is made for charging two smaller reservoirs and controlling a slightly increased volume of compressed air in the same length of time as when in empty position.

In empty position, the load brake cylinder, the load reservoir of 550 cu. ins. capacity, the take up reservoir of 160 cu. ins., and the reduction reservoir of 550 cu. ins., are at all times open to the atmosphere, and in either empty or load position and at all times the equipment is charged, the chamber F, in which the cut-out slide valve operates, is supplied with compressed air from the triple valve so that the slide valve is at all times held to its seat and the pressure equalizes on both sides of the cut-out piston when in "empty" position.

The object of the load reservoir is to store an additional auxiliary reservoir volume for the operation of the load brake cylinder.

The object of the take up reservoir is

to store an additional volume to produce an increased pressure in the empty brake cylinder when needed.

The use of the reduction reservoir is to permit of an expansion of load cylinder pressure as the cylinder is first brought into operation.

Valve 19 separates or prevents empty brake cylinder pressure from entering the load cylinder until the tension of its spring load is overcome.

The change-over valve separates the load cylinder and reduction reservoir after a certain pressure is obtained, this is also a "spring loaded" valve.

Valve 37 is a check valve that prevents a backward flow of air from the empty cylinder to the take up reservoir.

When the handle of the locking mechanism is turned to load position the operating levers are moved to open a valve which exhausts the pressure back of the cut-out piston, the pressure in chamber F then forces the piston to the right, making a joint on the spring box gasket and holding the cut-out slide valve in position to permit the triple valve to charge the load and take up reservoirs while the brake cylinders and the reduction reservoir remain open to the atmosphere.

The push rod of the load cylinder is of square section with the upper side notched to receive a pawl and the empty cylinder operating first, takes up the slack in the brake rigging and as the load cylinder cannot operate until the "empty" cylinder contains 24 lbs., the piston of the load cylinder travels but 1½ or 2 ins.

Due to this very short piston travel the additional volume of compression necessary for operating the load cylinder can be stored in the small chambers referred to, adding but a trifle to the volume of compressed air expanded.

Now it must be understood that in empty position the triple valve, auxiliary and "empty" brake cylinder are operating in perfect harmony with other train brakes, producing a braking power of 60 per cent. of the empty car weight based upon a 50 lb. cylinder pressure and when turned into "load" position 40 per cent. of the total weight of car and load is braked and based upon 50 lbs. cylinder pressure, therefore in order to keep the proper amount of braking power per pound of brake pipe reduction, it is absolutely necessary to use the single cylinder at high pressure at the start of the application and to change to the use of two cylinders and temporarily lower the pressure as the change occurs.

This is accomplished in the following manner: When the car is loaded and the brake is turned into its "load" position, a brake pipe reduction on the charged equipment causes the triple valve to move to either quick service or full service position, quick service on the modern train, and in this position air pressure enters the "empty" brake cylinder from the auxiliary reservoir, from the brake pipe through the quick service port, from the take up reservoir and from the load reservoir, with the result that a 7 lb. brake pipe reduction produces about 24 lbs. brake cylinder pressure, assuming that the piston travel is 8 ins.

The same reduction on the empty car or standard equipment with the same piston travel will result in about 8 lbs. cylinder pressure.

It is obvious that if a 7 lb. reduction produces 24 lbs. cylinder pressure a few more pounds reduction would result in equalization between that cylinder and the stored volume and thus prevent any further increase in the per cent. of braking power, therefore the load cylinder is brought into operation as soon as the "empty" cylinder pressure overcomes the tension of the spring under valve 19. A glance at the smaller cut will show how the pressure flows from the "empty" cylinder past this valve into the load cylinder. The tension of the spring is overcome and the valve unseated when the "empty" cylinder pressure reaches about 24 lbs.

As the pressure enters the "load" cylinder it also passes through a portion of the "change over" valve to the reduction reservoir and as soon as this reservoir absorbs volume enough to produce about 12 lbs. pressure, spring 23 will be compressed and the reduction reservoir is separated from the brake cylinders by the valve 25 until the brake is again released.

The reason for this action is that when the "load" cylinder comes into operation the brake cylinder piston area is doubled and the pressure must be lowered to prevent an unwarranted increase in braking power, and to maintain uniform braking power the pressure is halved as the piston area is doubled.

After this action takes place further brake pipe reductions build up brake cylinder pressures on the "load" equipment at the same rate, and with the same retarding effect that is obtained on the single cylindered car when it is empty.

With light brake pipe reductions, up to where the load cylinder comes into action, the brake cylinder pressure per pound brake pipe reduction is 6.5 lbs., absolute pressure, and the braking power delivered per pound brake cylinder pressure is .342 per cent.

When the "load" cylinder comes into action the pound brake cylinder pressure per pound brake pipe reduction changes from 6.5 lbs. absolute to 3.25 absolute and the per cent. per pound brake cylinder pressure changes from .342 per cent. to .8 per cent., thus in the first case the additional braking power for the load is developed by pressure and in the second case, by increased piston area.

The foregoing, in addition to the description in last month's issue, will serve as a general description of this brake equipment and in next month's issue the operating valves will be shown in the several positions mentioned.

At a first glance this brake looks somewhat formidable but after an evening spent in a study of it, the simplicity of the arrangement is astonishing and we know that many of our readers will know the operation of this brake from a study of the two views shown.

Mathematics.

With reference to the braking power problems that arise in connection with the "Empty and Load" freight brake equipment, we desire to state that it is not always absolutely necessary for the air brake inspector or repairman to know how to calculate leverage and braking power, but it is unquestionably to his advantage to be able to do so. It is not necessary for any railroad air brake man to apply a knowledge of higher mathematics, or deal with the cube root, the logarithm or algebraic equation in his everyday occupation, even if he is competent to do so, but every air brake man should have some knowledge of mathematics, not necessarily for the purpose of making him a mathematician, but for the purpose of developing in him a logical and reasoning mind.

We do not infer that a man may not have reason without a knowledge of mathematics, but when a man is always positive in expressing his convictions and sure that his opinions are right, we know that that man has never learned anything from a study of arithmetic.

Further than this we do not believe that it is necessary for the railroad air brake man to go very far beyond decimals and fractions, but he should be able to calculate leverage and understand the simple braking power problems which do not often go beyond ordinary multiplication and division, and he should have a general knowledge of the effects of forcing a brake shoe against a revolving car wheel.

The air brake man's study begins where the shoe is pressed against the wheel; the entire brake equipment is designed for this express purpose, and if we get no further along the subject of air brakes than valves, springs, ports and passages, we cannot call ourselves practical air brake men.

This term practical is very frequently misapplied, especially with reference to a mechanic who does his daily work without ever reading anything pertaining to his duties or who has an ingrowing hatred of books or periodicals in any form.

This man usually considers his knowledge practical instead of theoretical, whereas it is utterly impossible for him to be practical in any sense of the word.

Electrical Department

Electric Locomotives, N. Y., N. H. & H. R. R.

The New York, New Haven & Hartford Railroad first began operation with electricity in the spring of 1907. This electrification was forced upon the railroad by the electrification of the tracks of the New York Central R. R. into the New York Terminal, over which the New Haven operates for a distance of 12 miles.

Instead of continuing with the third rail direct current as adopted on the New York Central, the New Haven adopted the single phase system and electrified the four tracks of their main line to Stamford, Conn., a distance of 22 miles. Thirty-five high-speed passenger locomotives were purchased, suitable for operation on both the single phase and the direct current. A year later this number was increased to 41.

Although troubles were experienced at first, they were quickly eliminated and the results of operation by electricity were so gratifying to the officials that an appropriation was made to electrify the Harlem river branch, a six-track road about 15 miles long, joining the main line at New Rochelle, over which all of the freight is handled, and the freight yards containing many miles of track, by the single phase system. Shortly after work had started on this, another appropriation was made to extend the main line from Stamford to New Haven, an additional 34 miles of four track.

This increase in electrification will require many additional electric locomotives and in order to select the most suitable type the railroad company purchased three locomotives of different types which have been carefully tested for the past year and one-half. Each locomotive was the same as to speed, drawbar pull, etc., but different electrically and mechanically. These three test locomotives are as follows:

1. Locomotive of the side rod type with two large motors mounted one in each half of the locomotive which is articulated. Each motor by means of a connecting rod drives a jack shaft which is connected to two pair of drivers by side rods.

2. Locomotive of the geared type with four motors, each motor mounted above its driving axle and connected to same by pinion and gear. The gear is mounted on a hollow shaft or quill, surrounding the axle, fitted with six arms which engage with Leavy helical springs resting on the spokes of the wheel. This arrangement gives flexible drive and removes all shocks.

3. Locomotive similar to the second, but instead of one large motor per axle two smaller ones are used (see page 66, February, 1912).

From the results of these tests the N. Y., N. H. & H. R. R. have purchased from the Westinghouse Elec. & Mfg. Company 39 heavy service electric locomotives. An eight-motor driving arrangement similar to the third will be used, and an articulated running gear similar to the second. The arrangement of four twin-motor units—8 motors in all—has shown itself to be a very desirable arrangement for the following reasons:

1. Peripheral speed of the armature is a limiting feature in railroad motor design. With two small motors it is possible to use a rotative speed approximately twice that possible with one large motor. Each motor has, therefore, one-half the number of poles, and the two small motors have practically the same number of parts as required by one large motor.

2. Each small motor has a diameter practically half that of one equivalent large motor so that there is a saving in weight and space.

3. Each small motor exerts only one-half of the torque (turning force) and only a single gear is required and not one on each end of the armature shaft as required for the larger motor-test locomotive number two.

4. The use of the single gear gives more space between the drivers and the small motor can be longer, which permits of more economical design.

5. The eight motors actually cost less than do four motors having the same aggregate output.

6. The motors, being lighter, are much more easily handled when the locomotive is overhauled.

The articulated running gear has worked out very satisfactorily. The four pairs of driving wheels and two pairs of small leading wheels are in two groups having outside frames. The pulling and buffing strains are transmitted entirely through the truck frames which are braced transversely at the ends of the trucks and between the driving axles. The drawbar pull is transmitted from truck to truck by means of a drawbar adjusted to leave a ½-inch maximum clearance between

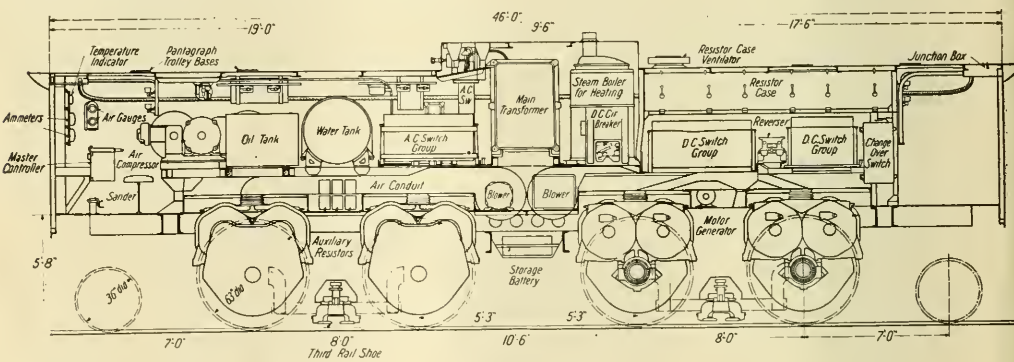


FIG. 1. LONGITUDINAL ELEVATION.

the end ties or bumper guides of the truck when all the slack is pulled out. The bumper guides are equipped with spring buffers to take up buffing shocks. Fig. 2 shows the drawbar between trucks and buffer springs.

The center pin mounted on a built-up structure midway between the driving wheels carries no weight, its only function is to hold the truck in alignment with the cab. The cab underframe is supported at four points, two at the inner ends of the truck, with centers 84 ins. apart transversely and the other two located between the truck wheels and the first driver with centers 34 ins. apart. This arrangement is duplicated on both trucks. The center pin of one truck is allowed a limited longitudinal movement, necessary when taking curves due to the fact that the two trucks are fastened together by the center drawbar. In general design and arrangement the 39 locomotives are the same, but three will operate on both alternating and direct current and will handle heavy passenger trains. These are designed to handle a trailing load of 800 tons at 45 amperes. The remaining 36 are for operation on single phase and are designed for fast freight. They will handle a trailing load of 1,500 tons at 35 amperes.

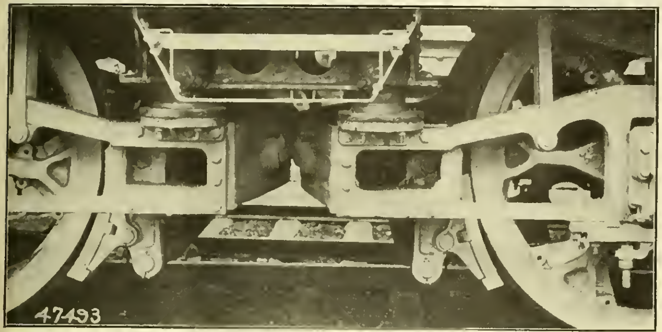


FIG. 2. SPRING BUFFERS AND BUMPER GIRDERS.

Fig. 1 shows the arrangement of apparatus and the location of the 8 motors, as well as the principal overall dimensions. The blowers are shown in position with the air ducts leading to the motors. These blowers are run while the locomotive is in operation to provide air for cooling the motors. By this method the motors can be entirely enclosed to keep out all dirt and can handle about 30 per cent. more load than would be possible without this ventilation.

In addition to the passenger and freight locomotives the railroad has purchased 16 switcher locomotives for switching freight in their immense freight yards. They are designed to operate on single phase only. Four motors are used, mounted above the axle and same arrangement of drive as on the second test locomotive. The switchers weigh approximately 80 tons and are built so that exceptionally heavy loads can be handled at slow speed. They are capable of exerting a tractive effort of 40,000 lbs. up to 6 miles per hour.

After all of the construction is completed and locomotives put in service the N. Y., N. H. & H. R. R. will have a large electrified division, over which all of the freight and passenger service will be handled by electric locomotives. It will be the largest electrification in the world.

The single phase system has been pronounced a failure; the answer to this statement is to point to the successful operation on the New Haven. After five years' operation with this system the officials are satisfied with the operation, costs of maintenance, and that this is the system for heavy trunk line service. If this system was a failure the railroad would not be spending several million dollars increasing the electric zone by the single phase power. The results reflect great credit to the Westinghouse Company, which first placed the single phase system in operation in this country and which has built all of the electrical apparatus for the power house and all of the locomotives for the New Haven Railroad.

Electrolytic Lightning Arrester.

Some means is necessary to protect electrical apparatus from lightning and high voltage static disturbances and surges so as to relieve the abnormal voltage and divert it from passing through the armature coils of an electrical machine or other electrical apparatus to ground, putting the apparatus out of service, meaning in many cases interference with continuity of service and expensive repairs.

Not only must this excess pressure be relieved, but to prevent damage the voltage at the machine should be prevented from reaching too high a value. To accomplish this result the protective device or lightning arrester must operate at a pressure below the breaking down point of the insulation on the electrical apparatus; it must permit the enormous though very brief currents to pass instantly, as any delay of the lightning current means a rise in voltage and damage to the apparatus; it must prevent the power current from following the path of the lightning through the arrester as soon as the abnormal conditions have been relieved.

Many lightning arresters are of the spark gap type, i. e., a series of gaps, the number depending on the voltage of the circuit, connected in series with resistance and are placed between the circuit and ground. This type of arrester, particularly for low voltage work, possesses the disadvantage that the voltage must rise to several times normal before the discharge takes place. This rise may be so rapid and reach such a value that before the spark gap arrester has relieved the conditions the electrical apparatus is damaged.

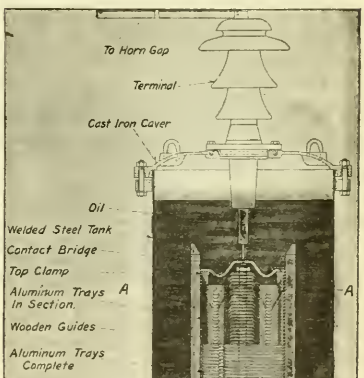


FIG. 3. WESTINGHOUSE ELECTROLYTIC LIGHTNING ARRESTER.

The electrolytic type of arrester is ideal for all circuits and especially for low voltage circuits. This type has

essential characteristics that enable it perfectly to fulfill the conditions specified above. It automatically offers a very high resistance to currents at normal voltage so that normally the circuits are not disturbed; it offers a very low resistance to voltages above a certain critical value, in other words, only a small increase in voltage is required for the arrester to work and relieve the abnormal conditions due to lightning. With this arrester the voltage cannot rise to such a high value that the electrical apparatus will be damaged; it offers a low effective resistance to currents of high frequencies which makes it very sensitive to lightning as very high frequencies are prevalent in lightning discharges.

The construction of this type of arrester and its workings are very interesting. Fig. 3 shows the mechanical construction. Cup-shaped aluminum trays are placed on properly insulated supports. The spaces between the trays are nearly filled with electrolyte, which is distilled water containing a salt in solution. The set of trays is placed in a tank and filled with oil. The top tray is connected with the circuit through a fuse and the lower tray to the ground.

When the arrester is first connected to the circuit a current flows through the plates and the electrolyte, and due to this flow of current a film is deposited on the trays which cuts the current down to practically zero. The increased voltage due to lightning breaks down this film, not in one place but over the whole surface of the aluminum trays in contact with the electrolyte, so that this abnormal voltage is quickly relieved. As soon as the power current commences to flow following the lightning discharge the film is built up again and the arrester is ready for another discharge.

Ohm's Law.

What is the relation between the voltage and current in a circuit? How can we tell with a certain voltage how much current will flow through a wire? On the face it appears a difficult problem but as a matter of fact it is very simple, especially for direct current circuits. The relation is established by what is known as Ohm's Law. This law is expressed in the form of an equation, namely, $C = \frac{E}{R}$, where C stands for the current, E for the voltage and R for the resistance of the circuit. With any two of the quantities known the third can be determined. The resistance of a circuit is just what the word means; it is the obstruction the circuit offers to the flow of current and must be overcome by the voltage or pressure. The larger the wire the less the resistance, and more current will flow. The resistance is expressed in terms of a unit called the ohm, and any handbook will give the resistance of any standard size wire for 1,000-ft. lengths.

Acid Proof Paint for Electric Storage Batteries.

The Third Ave. Railway Co., of New York City, have just completed a test on several kinds of paint to determine which would stand up best against the acid which spills, etc., from the storage batteries mounted in their small storage battery cars, onto the woodwork, etc. Pieces of wood of equal size and grain were chosen, each painted with a different kind of paint. The paint showing the best results and far superior to any of the others was the insulating enamel manufactured by the Sherman-Williams Paint Co. Electric storage batteries are used for many purposes and this information should be of value to many of our readers.

Human Race to Be Exterminated by Coal Burning.

There has been much unprofitable speculative writing done concerning conditions that will eventually extinguish life on the earth. A somewhat interesting series of calculations on this subject by a writer in the *English Mechanic* who says:

The writer expects we shall burn one hundred thousand million tons of coal in the next 38 years. I have roughly figured out what effect this would have on the atmosphere. If I am wrong, perhaps someone who is fonder of cyphering will correct me. I start with the assumption that 1 per cent. of CO_2 would weigh a little over 15 lbs. to each 100 sq. ins., and would take about 7½ lbs. of average coal to produce. Then, in 38 years, the CO_2 of our air will have increased by one-twentieth of one per cent. So there is no cause for immediate alarm. But when the whole world is producing coal and petroleum as Europe is today, ten times as much CO_2 might be produced. If this began in 100 years' time, in 500 years from now there would be 1 per cent. of CO_2 in the air. In 900 years from now 3 per cent. of CO_2 would be the proportion, rising to 7 per cent. in 1,300 years, and 15 per cent. in 1,700 years. Moreover, combustion is seldom so complete that some carbon monoxide is not produced, and is poisonous in minute quantities, as well as other injurious substances. What is 1,700 years in the past history of man? Merely half the age of a respectable mummy. Microbes increase in their billions till they produce enough poison to kill themselves. And so will man if he listens to the absurd idea that small families means race suicide. Man must limit his numbers if he is to live even to the next Glacial epoch.

Preventing Collisions at Sea.

Sir Hiram Maxim has issued an extremely interesting pamphlet on "A New System for Preventing Collisions at Sea." Sir Hiram contends that, whereas all warm-blooded animals, including Man, have five senses, one animal—the bat—has a sixth sense, which enables it, as proved a century ago by the Abbe Spallanzani, to follow insects and seize them without seeing them. When a bat flies about in total darkness, the beat of its wings sends out a series of pulsations or waves, after the manner of sound-waves, but of too low frequency to be considered as sound. These waves strike against all surrounding objects, and, like light or sound, are reflected back to their source of origin. This is the mechanism of the bat's sixth sense. Construct an apparatus that will produce atmospheric vibrations of about the same frequency as those of the bat, but using two or three hundred horsepower of energy, and we shall get vibrations able to travel from the ship at least five miles, and send back to it a reflected echo strong enough to be detected. Such an apparatus Sir Hiram Maxim has constructed, and is willing to show the complete working drawings to all interested.

Bursting of Marine Boilers.

When the *Titanic* sank under the waters of the Atlantic a great volume of steam arose as the vessel went down, and many people believed that the boilers had exploded. Dealing with that subject the naval correspondent of the London *Morning Post* has something interesting to say on the subject of the bursting of the boilers aboard ship, of which so much has been heard. When a steamship sinks it is inevitable that reports should get about that the boilers burst as she went down. There is a roar and a great expulsion of steam from the funnels as the boilers become submerged, and it is assumed that this can only be caused by their bursting. It has, however, been proved over and over again that this effect is merely the result of the water suddenly reaching and putting out the fires; that there is no violent explosion within board, and that the bursting of boilers in such circumstances would be impossible.

During the continued drought of last summer we heard much speculation about rainfall and how much relief would come from a shower that precipitates one or two inches of rain. It takes a heavier shower than most people imagine to deposit an inch of water. An "inch of rain" means one gallon of water spread over a surface of nearly two square feet, or a fall of about one hundred tons of water on an acre of ground.

Heavy Hard Coal Burners for the Lackawanna

Seven powerful Pacific type locomotives designed to haul a 460-ton at a sustained speed of 30 miles per hour on 1.6 per cent. grades have recently been received by the Delaware, Lackawanna & Western Railroad from the American Locomotive Company. They will be used in service between New York and Elmira, and will replace a heavy class of 10-wheel locomotives having a total weight of 217,000 lbs. and a maximum tractive power of 34,860 lbs., with which the first-class passenger service is now handled. To accommodate the traffic it is necessary to run seven cars on the limited trains, making 380 tons behind tender. With a train of this weight, the ten-wheelers invariably lose from five to seven minutes through the mountainous districts. It has, therefore, been made the rule to furnish helpers on all the fast trains.

The new locomotives are designed to handle eight cars over the mountains on the present fastest schedules. This rating is made on a saturated steam basis. With the reserve capacity secured with the use of superheated steam they will be able to make the schedules unassisted with nine cars on 530 tons.

By the introduction of these more powerful modern Pacifics, the expense of double-heading will be eliminated and at the same time the present high standard of service maintained.

One of the most interesting of the new features is the long main driving boxes, designed to reduce the wear on the boxes and increase mileage before renewal of the bearings becomes necessary.

Screw reverse gears, which practice was first introduced in this country by these builders in their experimental locomotive No. 50,000, are applied to all the engines. This device has also been improved by the use of a ball joint connection between the reach rod and the screw gear crosshead. This arrangement obviates the necessity, under ordinary conditions, of offsetting the reach rod to connect to the reverse shaft arm.

In the design of the boiler, the principal feature of interest lies in the fact that one of the locomotives is equipped with the "Security" brick arch. The boilers of the other locomotives in the order are also so designed that the arch can be applied later if desired. This is another instance of the application of this device to hard-coal burning engines, and it will be interesting to watch the results.

The boiler is equipped with the Locomotive Superheater Company's superheater of the top-header, double loop type, giving a superheating surface of 821 sq. ft. figured on the basis of the inside diameter of the superheater tubes.

The following are the principal dimensions of this type of locomotive:

Cylinder—Type, simple piston valve; diameter, 25 ins.; stroke, 28 ins.

Track gauge—4 ft. 8½ ins.; tractive power, 40,800 lbs.

Wheel base—Driving 13 ft., rigid 13 ft., total, 34 ft. 10 ins.; total engine and tender, 69 ft.

Weight—In working order, 284,000 lbs.; on drivers, 179,500 lbs.; engine and tender, 443,600 lbs.

Heating surface—Tubes, 3,579 sq. ft.; firebox, 239 sq. ft.; total, 3,818 sq. ft.; superheater, 821 sq. ft.

Grate area—94.8 sq. ft.

Axles—Driving journals, main, 11 ins. x 21 ins.; others, 10½ ins. x 13 ins.

Boiler—Type, straight top; O. D. first ring, 78 ins.; working pressure, 200 lbs.; fuel, anthracite coal.

Firebox—Type, wide; length, 126 ins.; width, 108¼ ins.; thickness of crown, ⅜ in.; tube, ½ in.; side, ⅜ in.; back, ⅜ in.; water space, front, 6 ins.; sides, 5 ins.; back, 5 ins.

Crown—Staying, radial.

Tubes—Material, charcoal, iron, No. 252; diameter, 2 ins.; length, 20 ft.; gauge, No. 11 B. W. G.

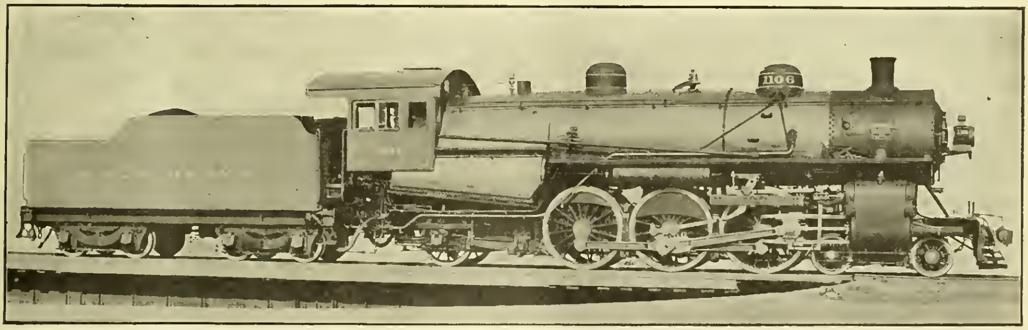
Piston—Rod, diameter 4½ ins.

Smoke stack—Diameter, 16 ins.; top above rail, 15 ft. 3 ins.

Tank—Style, water bottom; capacity, 8,000 gals.; fuel, 14 tons.

Valves—Type, piston, 14 ins. diameter; travel, 6½ ins.; steam lap, 1⅛ ins.

Wheels—Driving, diameter outside tire, 73 ins.; center diameter, 66 ins.; engine truck, diameter, 33 ins.; trailing truck diameter, 50 ins.; tender truck diameter, 36 ins.



PACIFIC TYPE OF LOCOMOTIVES FOR THE DELAWARE, LACKAWANNA & WESTERN RAILROAD.
U. C. Manchester, Superintendent of Motive Power. American Locomotive Company, Builders.

Railway Extension There and Here.

The Daily Consular Trade Reports which we receive tell of decided activity in railway enterprises in all countries on the American continent except the United States. Even Mexico, in spite of rebel troubles, has a variety of railway extensions proceeding actively. Meanwhile rustic legislators in the United States have suspended their persecution of railway interests, but people who provide the money that promote railway enterprises are keeping their capital away from railways; so in the midst of general prosperity railway extension is at a standstill.

The current business policy of the Harriman lines may be taken as representing the tendency of American railways generally. Mr. Julius Kruttschnitt, director of operation of the Harriman system, is lately reported as having said:

"There is nothing in the way of new construction programme for our system. Any one could possess himself of that fact by looking at the earning statements for May of a large number of roads across the country. There is nothing in the trend of railroad earnings to justify a programme of expansion. So far as the political prospect is concerned, we have had so much of a political burden to bear for the last eight or ten years that the average man looks forward to whatever change with something akin to hope in his analysis of the possibilities."

Traveling Engineers' Committees, Etc.

Secretary Thompson, of the Travelling Engineers' Association, has issued the following schedule of rates for the Hotel Sherman during the annual convention, and urges members to apply for rooms without loss of time:

Following please find rates that have been obtained at the Hotel Sherman for members, their families and friends:

60 rooms with bath, single $2, double $3 per day; 100 rooms with bath, single $2.50, double $3.50 per day; 200 rooms with bath, single $3, double $4; 150 rooms with bath, single $3.50, double $5; 100 rooms with bath, single $4, double $6.

The Pullman Company has again, and for the twentieth time, extended to the members who are in railroad service and entitled to free transportation, also the dependent members of their families, one-half rates to and from the convention.

In addition to the very fine exhibit that will be at the Hotel Sherman, the supply people give all those attending the convention an earnest invitation to visit the Karpen building, on Michigan avenue, where the largest exhibit of railway supplies in the country can be seen.

FUEL ECONOMY.

The committee on fuel economy, of which Mr. F. P. Roesch is chairman, assisted by Messrs. Dan Daley, J. R. Scott, Y. Z. Merriman, S. J. Madden, G. E. Spangler and G. M. Carpenter, has sent out the following circular of inquiry—answers to be sent to Mr. F. P. Roesch, Box 871, Douglas, Ariz.:

The undersigned have been appointed a committee on the subject of "Fuel Economy. What relation do mechanical appliances, such as locomotive superheaters, mechanical stokers, brick arches, and the handling of trains have on this subject," to be discussed at our next annual meeting, and we would thank you to forward to the chairman of the committee any and all information you may have on the above subject, and beg to submit the following questions:

No. 1. In order to get the information desired in as clear a manner as possible, I would suggest that we consider first economy due to locomotive superheaters. Have you any locomotives equipped with superheaters on your line? If so, have you made any comparative tests between engines of the same type and capacities, the one equipped with superheater and the other using saturated steam. If so, what economy, if any, have you found that could be attributed to the use of the superheater, advising type of superheater used.

No. 2. Have you any locomotives equipped with mechanical stokers? If so, please advise type and if you have made any comparative tests advise result of same, being particular to specify whether the use of mechanical stoker has decreased the consumption of fuel per ton mile or increased it. You understand what we are driving at in this connection is to find out whether or not the application of a mechanical stoker will result in a saving of fuel or otherwise.

No. 3. Brick arches. Have you any locomotives equipped with brick arches? If so, please specify type of brick arch and if you have made any comparative tests between engines of the same type in the same service, the one equipped with brick arch and the other without it, please advise results so far as fuel consumption is concerned.

No. 4. The handling of trains. This is a subject that is frequently overlooked in determining fuel economy, and in this connection I believe it would be advisable to state the effect on fuel consumption is when the weight of train is taken into consideration. That is, the consumption of fuel increased per ton mile per hour with train rating so that the average speed is, say, about ten miles per hour, as compared with train rating where the average speed will exceed ten miles per hour, say, from fifteen to eighteen miles per hour. Also kindly give us your ideas as to any other method in which a change in the handling of trains, especially freight trains, would result in economy in fuel. I believe it would be well to extend this matter a little further, and include in the subject mechanically operated fire doors and mechanically operated grate shakers. That is to say, if you have had any locomotives equipped with the air operated fire door has it resulted in an increase or decrease in fuel consumption per ton mile. If so, kindly give your reasons in full and also if you have any locomotives equipped with air or steam operated grate shakers, kindly give results, advising whether it has resulted in an increase or decrease in fuel consumption, and state fully your reasons.

Any further information on this subject will be heartily appreciated, as it is our desire to make this one of the best papers at our next meeting, and, of course, in order to make the paper a success it will be necessary to have your full and hearty co-operation.

INCREASED EFFICIENCY OF LOCOMOTIVES AND BENEFITS DERIVED FROM CHEMICALLY HEATED WATER.

Mr. Fred McArdle is chairman of the committee appointed to investigate this subject, and he is assisted by Messrs. Geo. Austin, W. S. Reid, W. H. Wallace, Wm. Daze, W. D. Cooper, and T. F. Lyons.

The following circular of inquiry has been sent out, the answers to go to Mr F. McArdle, 607 Guenther street, San Antonio, Tex.:

No. 1. Do you treat feed water in your territory? If so, to what extent, and what system is used?

No. 2. State whether your treatment is by the use of treating plants or by using chemicals in the engine tank, or by direct injection through the injector or its attachments.

No. 3. If you are using feed water treatment, or chemical treatment in engine tanks, what is the approximate cost per 1,000 gallons?

No. 4. Do you use treated water in all classes and sizes of engines?

No. 5. What is the character of your grades?

No. 6. What precaution do you take before ascending heavy grades when using treated water to prevent the engine from raising her water, with the resultant effect of destroying the efficiency of the engine?

No. 7. Do you use treated water for the purpose of preventing incrustation?

No. 8. Do you use water treatment to prevent foaming?

No. 9. Can you give approximate figures of mileage of flues and fireboxes since adopting the use of chemicals as compared with mileage before treating your feed water?

No. 10. Do you find that water treated in treating plants increases or decreases foaming?

No. 11. Do you find that the use of chemicals in engine tanks, or through the injector direct, decreases foaming?

No. 12. Do you find that the use of treated water, either in treating plants or through the engine tank, increases or decreases mileage between washouts?

No. 13. What, if any, is the increase of tonnage and efficiency of your engines in general after adopting the use of chemicals as compared with the service before the use of treated water? Give specific cases of performance.

No. 14. Does the use of treated water increase or decrease injector and check troubles?

No. 15. Do you find that increased foaming, due to treating plants, increases the cost of maintenance of working parts of locomotives?

No. 16. Are your locomotives equipped with blow-off cocks? If so, how many, and what is their location?

No. 17. What are your instructions to engineers as to the manner and time at which the blow-off cocks should be used?

No. 18. Are the operating devices of the blow-off cock so arranged that they can be operated from the cab?

No. 19. If you are using anti-foam compound instead of chemically treated water, to what extent?

No. 20. Have you any method of settling water that is taken from muddy rivers or reservoirs? If so, does your

system increase the mileage between washouts?

No. 21. What arrangement have you for keeping sludge out of the chemically treated or filtered water?

No. 22. Do you find that the temperature has any effect on the chemically treated feed water?

No. 23. What are the beneficial, as well as the injurious effects, of using soda-ash direct in tanks of locomotives?

HANDLING OF LONG PASSENGER AND FREIGHT TRAINS WITH MODERN AIR BRAKE EQUIPMENT.

Mr. W. F. Walsh has been appointed chairman of a committee to report on this subject. The assisting members are Messrs. E. F. Wentworth, W. Turner, C. W. Wheeler, H. A. English and H. A. Flynn. They issue the following circular of inquiry, replies to be sent to W. F. Walsh, P. O. Box 174, Gordonsville, Va.:

No. 1. What rules or methods do you follow, if any, as to alternating loads and empties in the make-up of freight trains, so as to avoid excessive braking power in any one point in the train?

No. 2. What terminal test, if any, do you make to ascertain the brake pipe leakage in freight trains and what amounts do you recommend for various train lengths?

No. 3. What instructions, if any, do you issue to enginemen, as to starting and stopping long trains to avoid undue shocks or break-in-two, and what do you find to be the most common cause of break-in-two?

No. 4. Which, in your experience, is preferable, a light or heavy initial reduction, in handling long trains with empties and do you advise using steam during the initial reduction?

No. 5. What is your experience with the "K" triple valves in long freight trains? Have you any data as to the effect of light and heavy reductions, and the resultant shocks in long trains with the "K" triples?

No. 6. Have you found any ill effects in handling brakes, where the head end of the train was equipped with the older type of triple, while there were a large number of "K" triples in the middle or rear end of the train, if so, what were the results?

No. 7. Do you find that the use of "K" triples in the head end of trains is conducive to preventing break-in-two? Have you had any trouble with wheel sliding due to the retarded release feature of this type of triple?

No. 8. Have you had any experience with the use of thirty and fifty pound retainers, if so, do you consider their use beneficial or detrimental?

No. 9. What are your recommendations as to the use of the straight air brake on engines in connection with handling trains? Have you had any ill effects from the use of Holding position with the "ET" or "LT" equipments?

No. 10. What are your instructions to enginemen backing long trains in and out of side-tracks, in reference to preventing break-in-two?

No. 11. What experience, if any, have you had with the Westinghouse "LN" or the New York "J" equipments in passenger service?

No. 12. Do you find it necessary to issue any special instructions to enginemen handling trains with these equipments, other than instructions covering the handling of the previous types of High Speed equipment?

No. 13. Have you had any trouble with stuck brakes on passenger trains equipped with either the Westinghouse "LN" or the New York "J," or on cars with double equipment? If so, how do you account for this, and what instructions do you issue to enginemen to overcome this trouble?

No. 14. What effect on the running of slasck does the "ET" or the "LT" brake on locomotives have, when applied with a heavy initial reduction in long passenger train service at high speed? At low speed (less than ten miles per hour)?

No. 15. Are you operating long passenger trains on your road fully equipped with modern air brake equipment, and if so, do you follow the two application method in ordinary service stops or do you use the graduated release with such equipment?

HOW CAN THE TRAVELING ENGINEER GET ENGINEERS AND FIREMEN INTERESTED IN ECONOMICAL USE OF FUEL AND LUBRICATING MATERIAL, ETC.

Mr. Robert Collett has been appointed chairman of the committee to report on this subject, assisted by Messrs. J. T. Meredith, D. L. Ewebank, L. Redford, W. H. Donohue, J. S. Linsley, and C. F. Schraag. The following circular was sent out:

1. Do you have a published performance sheet on fuel? If so, do you get this information early enough to be of material benefit in locating excessive use of fuel?

2. What plans are in effect on your road for notifying enginemen of what constitutes good performance, and are enginemen instructed to notify you if an excessive amount of fuel is used on any particular trip, and if so, how is this handled?

3. In your opinion, would it be practical to separate fuel used at terminal in order that crews will be charged only with the fuel they actually handle, and in your opinion would it be practical to have a tally kept of number of shovels of coal used in terminal on each engine?

4. Please furnish in detail the methods employed on the lines you are familiar with, on the education of the firemen along the lines of fuel economy and use of lubricating material.

5. Please give your opinion on value of following methods of instruction:

(a) Progressive Examination for Firemen.

(b) Individual or Class oral instruction.

(c) Charts and Stereopticon views on use of fuel and lubricants.

6. In your opinion do results obtained justify the railroad company in publishing books for free distribution to individual enginemen, or would it be better for them to purchase their own books, the traveling engineer offering suggestions as to suitable literature?

7. Give your views as to effect on fuel consumption of lubricating methods on pooled vs. regular engines, and should the oil schedule be more liberal on pooled than regular engines?

8. To what extent do other operating officials, aside from the traveling engineer interest themselves in the economical use of fuel and lubricating material, with view of maintaining interest of the enginemen and calling attention to improper practices or complimenting the crew on good performance?

Please address all communications to Mr. Robert Collett, Superintendent Locomotive Fuel Service, St. L. & S. F. Railway, Springfield, Mo.

WHAT ARE THE ADVANTAGES VS. DISADVANTAGES OF LEAD ON MODERN HIGH CLASS LOCOMOTIVES?

Mr. J. F. Jennings has been appointed the committee required to report on above subject. He has sent out the following circular, answers to be addressed to him at 442 Hubbard avenue, Detroit, Mich.

No. 1. How much lead do you allow passenger, freight and switch engines with slide valves and Stephenson motion?

In replying to this and subsequent questions, please state whether you make any difference in the lead given to engines using superheated steam from those of the same class using saturated steam.

No. 2. How much lead do you allow passenger, freight and switch engines with piston valves and Stephenson motion?

No. 3. How much lead do you allow passenger, freight and switch engines with slide valves and Walschaert gear?

No. 4. How much lead do you allow passenger, freight and switch engines with piston valves and Walschaert gear?

No. 5. Have you had engines in service without lead, and, if so, state kind of service, type of valves, and valve gear, and briefly results obtained?

No. 6. Have you experimented with different leads on various types of engines in service, and, if so, give briefly results obtained?

No. 7. Have you a standard lead for different types of engines in same service?

Items of Personal Interest

Mr. F. W. Johnson has been appointed master mechanic of the Nevada Copper Belt, with office at Mason, Nev.

Mr. J. E. Tierney succeeds Mr. A. J. Wade as master mechanic of the Louisiana & Arkansas at Stamps, Ark.

Mr. J. R. Sexton has been made mechanical superintendent of the Santa Fe, northern district, office at La Junta, Colo.

Mr. H. T. Douglas, Jr., has been appointed chief engineer of the Chicago and Alton, with headquarters at Chicago, Ill.

Mr. T. F. Sullivan, division master mechanic of the San Antonio & Aransas Pass, with office at Yoakum, Tex., has resigned.

Mr. John McClain has been appointed master mechanic of the Pittsburgh, Lisbon & Western, with office at New Gallilee, Pa.

Mr. W. D. Johnston, division master mechanic of the International and Great Northern, with office at Palestine, Tex., has resigned.

Mr. J. J. Carey succeeds Mr. Charles A. Gill as master mechanic of the Baltimore & Ohio Southwestern, with office at Washington, Ind.

Mr. R. L. Stairs has received appointment as Chief Dispatcher of the Chesapeake & Ohio of Indiana, with headquarters at Peru, Ind.

Mr. W. H. Berger succeeds Mr. Wm Pearson as superintendent of motive power of the Indian Creek Valley, with office at Connellsville, Pa.

Mr. Peter McQuaid, roundhouse foreman of the Prince Edward Island Railway, has been appointed master mechanic at Charlottetown, P. E. I.

Mr. Carl Gray, Jr., has been appointed assistant engineer of the United Railways Company and the Oregon Electric Company, with offices at Portland, Ore.

Mr. H. W. Jacobs has resigned as assistant superintendent of motive power of the Santa Fe System, effective July 1, to devote his time to private business.

Mr. Frank Rusch has been made general master mechanic of the Chicago, Milwaukee & Puget Sound at Tacoma. Wash., vice Mr. N. M. Maine, deceased.

Mr. Carl Gray, Jr., has been appointed assistant engineer of the United Railways Company and the Oregon Electric Company, with offices at Portland, Ore.

Mr. J. E. Sentman has been appointed road foreman of engines of the Baltimore & Ohio, in charge of locomotives between Philadelphia, Pa., and Baltimore, Md.

Mr. John C. Brennan has been appointed road foreman of engines of the Adirondack division of the New York Central, in place of Mr. M. J. Graves, assigned to other duties.

Mr. C. J. Rogers, acting purchasing agent of the White Pass and Yukon Route at Vancouver, B. C., has been appointed purchasing agent, with office at Vancouver.

Mr. J. C. Morrison has been made master mechanic of the Burlington at Omaha, vice Mr. A. N. Willsie, made chairman of the company's fuel committee at Chicago.

Mr. C. L. Adair, master mechanic of the Kansas City, Mexico & Orient, has been transferred from Sweetwater, Tex., to San Angelo, on account of headquarters being transferred.

Mr. John C. Mill, signal inspector of the Chicago, Milwaukee & St. Paul, has been appointed assistant signal engineer, with office at Milwaukee, Wis. He succeeds Mr. H. K. Loury, resigned.

Mr. J. D. Crowley, formerly general foreman of the Georgia & Florida at Douglas, Ga., has been appointed general foreman of the Atlanta, Birmingham & Atlantic, with office at Fitzgerald, Ga.

Mr. B. F. Aikens has been appointed purchasing agent of the Michigan Central, with office at Detroit, Mich., in place of Mr. J. F. Farrell, who resigned to take a position with another company.

Mr. Frank Zeleny, assistant superintendent of the Chicago, Burlington & Quincy shops at Aurora, Ill., has been appointed engineer of tests, with office at Aurora, in place of Mr. W. A. Derby, deceased.

Mr. H. Osborne has been appointed assistant superintendent of motive power of the Canadian Pacific, in place of Mr. L. R. Johnson, who has been appointed general superintendent of the Angus shops district, Montreal.

Mr. J. Wellman, formerly road foreman of engines on the Santa Fe at Argenta, Kan., has been appointed master mechanic on this same road at Newton, Kan., in place of Mr. James F. McDonough, promoted.

Mr. J. E. Taussig, superintendent of terminals of the Galveston, Harrisburg and San Antonio at Houston, Tex., has been appointed superintendent of the Houston division of the same road, with office at San Antonio.

Mr. B McBride has been appointed master mechanic of the Southern and the Augusta Southern, with office at Charleston, S. C. Mr. H. B. Nabor succeeds Mr. McBride as general foreman of the Southern at Greensboro, N. C.

Mr. H. M. Oakes, formerly employed at the Mill street roundhouse of the Baltimore & Ohio at Cincinnati, O., has been appointed roundhouse foreman at the Gist street shops of the Cincinnati Hamilton & Dayton, Cincinnati, O.

Mr. W. L. Rohbock, assistant to the chief engineer of the Michigan Central at Detroit, Mich., has been appointed division engineer, with office at Bay City, Mich. He succeeds Mr. E. R. Lewis, who has accepted service with another company.

Mr. E. E. Calvin, vice-president and general manager of the Southern Pacific at San Francisco, Cal., has been elected vice-president in general charge of operation and construction. Mr. C. J. Hilles has been appointed assistant to the president.

Mr. D. R. Morris has received appointment as Signal Engineer of the El Paso & Southwestern with headquarters at El Paso, Tex. He succeeds Mr. E. E. Backus, resigned. Mr. Morris was lately connected with the signal department of the Illinois Central.

Mr. T. Rumney, assistant vice-president in charge of the mechanical department of the Chicago & Rock Island, and Mr. J B. Kilpatrick, mechanical superintendent of the same road, have had their jurisdiction extended over St. Paul and Kansas City Short Line.

Mr. J. R. Gould, formerly superintendent of motive power of the Virginia division of the Chesapeake & Ohio, has been appointed general superintendent of motive power, succeeding Mr. J. F. Walsh, who remains in the company's service in an advisory capacity.

Mr. Samuel G. Thomson, acting superintendent of motive power and rolling equipment of the Philadelphia & Reading, and subsidiary companies, at Reading, Pa., has been appointed superintendent of motive power and rolling equipment, with office at Reading.

Mr. J. R. Decker, formerly assistant signal engineer of the Michigan Central at Detroit, Mich., has been appointed acting chief engineer, with office at

Cleveland, Ohio, succeeding Mr. H. T. Douglas, Jr., chief engineer, who has taken a position with the Chicago & Alton.

Mr. James N. Hill, son of Mr. J. J. Hill, and vice-president of the Northern Pacific, has retired from the vice-presidency. He will be succeeded by Col William P. Clough, who has been identified with the Northern Pacific as a director, member of the executive committee and as legal adviser for a number of years.

Mr. R. B. Reynolds has resigned as roundhouse foreman of the Santa Fe at Argentine, Kan., to become master mechanic of Smith-Austin Co. at Sheffield, Mo. Mr. A. O. Stovel has resigned as shop foreman at Argentine to accept a similar position on the Houston & Texas Central at Houston, Tex. Mr. James succeeds Mr. Stovel at Argentine.

Mr. J. P. McMurray has been appointed master mechanic of the Rio Grande division of the Santa Fe, with office at Albuquerque, N. M. Mr. McMurray has been thirty-five years in the employ of the company, and has filled almost every position in the mechanical department from wiper to master mechanic. He is a fine type of the western railroad man.

Mr. J. H. Clark, master mechanic of the Staten Island Rapid Transit Railway at Clifton, S. I., has been appointed superintendent, with office at St. George, S. I., in place of Mr. P. H. Cassidy, and Mr. John O'Connor has been appointed assistant master mechanic, with office at Clifton, S. I. Mr. O'Connor is the inventor of several valuable mechanical devices.

Mr. E. F. Stroch, formerly master mechanic of the Colorado division of the Missouri Pacific at Hoisington, Kan., has been appointed master mechanic of the Kansas City Terminal division, with office at Kansas City, Mo., and Mr. W. G. Seibert, formerly master mechanic of the Omaha division at Falls City, Neb., succeeds Mr. Stroch, and Mr. J. D. Young, formerly general foreman at Atchison, Kan., succeeds Mr. Seibert.

Mr. C. E. Gossett, general master mechanic of the Minneapolis & St. Louis at Minneapolis, Minn., has prepared a concise and comprehensive book of instructions to locomotive firemen, to which are attached questions for examination of firemen. Mr. Gossett has for many years been actively interested in the better education of railway men and the examination book just published is the result of many years' familiarity with the subject.

Mr. George Bradshaw, general safety agent of the New York Central Lines, delivered a lecture on "The Safe Course for Railroad Men" in the Bucklen Opera House, Elkart, Ind., on July 25. The division and shop safety committee of the Michigan and Western divisions attended in a body and a very large attendance of railroad men were present. The discussion that followed Mr. Bradshaw's admirable talk was of the most interesting kind.

Mr. Jacob Johann, of Springfield, Ill., for many years identified with the Illinois Central, has presented to the library of the University of Illinois a complete file of the Proceedings of the American Railway Master Mechanics' Association and a large collection of miscellaneous volumes of interest to the Department of Railway Engineering. Mr. Johann was president of the Master Mechanics' Association in 1886-7 and is now one of its distinguished honorary members.

Mr. W. L. Allison has been appointed general western sales manager of the American Arch Company, with headquarters in the McCormick building, Chicago. Mr. Allison, who now represents the Franklin Railway Supply Company, will hereafter represent both concerns. Mr. F. T. Heffelfinger, of Minneapolis, has been elected vice-president of the American Arch Company, vice C. B. Moore, resigned, to accept the position of vice-president of the Jacobs-Shupert Fire Box Company.

The following organization of the Georgia & Florida Railway is announced by Superintendent D. F. Kirkland, with headquarters at Douglas, Ga.: Mr. J. F. Sheahan, Master Mechanic; Mr. George F. Dickson, Master of Trains; Mr. James S. Denham, Car Accountant; Mr. W. A. Walker, Roadmaster, Line North of 92 M. P., including Millen Branch; Mr. J. W. Buchanan, Roadmaster, Line South of 92 M. P., including Broxton and Moultrie branches and jurisdiction over Douglas Yard. The title of Assistant Superintendent is discontinued.

Mr. R. J. Turnbull, formerly acting superintendent of machinery of the eastern district of the Missouri Pacific, St. Louis, Iron Mountain & Southern, has been appointed mechanical superintendent of the entire system, with office at St. Louis, Mo., and Mr. W. L. Tracy, formerly assistant superintendent of machinery of the Western district, has been appointed general master mechanic of the Eastern district, with office at St. Louis. Mr. W. C. Smith, formerly master mechanic at Kansas City, has been appointed general master mechanic, with office at Kansas City, and Mr. W. D. Cunningham, formerly assistant superintendent of machinery of the Southern district, has been appointed general master mechanic of the Southern district, with office at Little Rock, Ark. The office of assistant superintendent of machinery of each district has been abolished and the duties of these officers will devolve on the general master mechanics.

OBITUARY.

William A. Denby.

The death is announced of Mr. William A. Denby, acting engineer of tests of the Chicago, Burlington & Quincy, with office at Aurora, Ill. He was engaged with the road for fourteen years and did excellent work in the company's laboratory at Aurora. He was a graduate of the Iowa College at Grinnell, Ia., and also spent four years in the Armour Institute of Technology at Chicago. Mr. Denby was in his fortieth year. His death is much regretted.

James Edmund Childs.

The New York, Ontario & Western has suffered a severe loss in the death of Mr. James E. Childs, vice-president and general manager, who died last month as the result of a surgical operation. Mr. Childs was in his sixty-fifth year. He had filled many important offices in the engineering department of various railroads. He was appointed general manager of the New York, Ontario & Western in 1886. His kindly and genial disposition made him many friends and he was universally esteemed among the employees of the road.

Charles Kennedy.

The death is announced of Mr. Charles Kennedy, a well-known western railroad man, who had filled the positions of roundhouse foreman, general foreman and assistant master mechanic on the Union Pacific, and also on the Southern Pacific. For several years he was chief engineer of the city of Santa Barbara, Cal., and while in the discharge of his duties was severely injured by an explosion of natural gas, and from the effects of which he never completely recovered. Mr. Kennedy, in his younger years, was a prominent athlete and won many prizes in the competitions in the East. Mr. Kennedy had passed his sixtieth year. His death occurred at Los Angeles, Cal., last month, the immediate cause being pneumonia. He had been employed in the Harriman lines over thirty years and was a fine type of the older class of all round mechanics.

John Soutar.

Mr. John Soutar, one of the oldest and best-known Scottish engine drivers, died a few weeks ago. His most celebrated exploit was to drive the record-breaking West-coast train during the railway race of 1895, on the last stage of its journey from London to Aberdeen, the entire run of 540 miles being covered on that occasion in 512 minutes, equal to an average speed of over 64 miles an hour. On arriving at Aberdeen at the close of this historic run, Mr. Soutar was lifted bodily from the footplate by a crowd of enthusiastic West-coast partisans.

Notes of the International General Foremen's Association Convention, and Exhibits.

The convention of the International Railway Foremen's Association was more than usually interesting this year, not only on account of the importance of the subjects discussed, but also on account of the fact that several of the leading railway men of the West made special addresses before the members. These were received with strong marks of approval. The entertainment provided was also of a high class, and reflects great credit on the various committees. The officers and committeemen were nearly all present and much of the success of the convention was owing to their intelligent activity.

The officers and committee were: President, Mr. F. C. Pickard, M. M., Pere Marquette Railroad, Saginaw, Mich.; first vice-president, Mr. J. A. Boyden, general foreman, Erie Railway, Hornell, N. Y.; second vice-president, Mr. T. F. Griffin, general foreman, C., C., C. & St. L. Railway, Indianapolis, Ind.; third vice-president, Mr. W. Smith, foreman, C. & N. W. Railway, Fremont, Neb.; fourth vice-president, Mr. L. A. North, general foreman, I. C. Railway, Chicago, Ill., and secretary-treasurer, Mr. L. U. Bryan, Two Harbors, Minn Executive Committee, chairman, Mr. E. F. Fay, assistant M. M., U. P. Railway, Cheyenne, Wyo.; secretary, Mr. Wm. Hall, M. S. For., C. & N. W. Railway, Escanaba, Mich.; Mr. W. W. Scott, shop superintendent, Pere Marquette Railway, Saginaw, Mich.; Mr. W. T. Gale, demonstrator, C. & N. W. Railway, Chicago, Ill., and Mr. W. G. Reyer, G. F. L. D., N. C. & St. L. Railway, Nashville, Tenn.

Among those who made special addresses were Mr. James F. Devoy, assistant superintendent motive power, C., M. & St. P. Railway; Mr. W. L. Park, vice-president and general manager, I. C. Railway; Mr. W. J. Tollerton, mech. supt., C., R. I. & P. Railway, and Hon. MacLay Wayne, first assistant corporation counsel, Chicago, Ill., who made a very happy address of welcome which was eloquently responded to by Mr. W. W. Scott, Saginaw, Mich. President Mr. F. C. Pickard also made an excellent opening address which was received with much enthusiasm.

The entertainments consisted chiefly of a sumptuous banquet in the Hotel Sherman, visits to the Riverside Exposition and various theaters. Automobiles were also at the disposal of the members and their friends and it is needless to say that the vehicles were fully taken advantage of.

The Executive Committee of the Railway Supply Men's Association were also much in evidence and the exhibits this year under their charge were many and varied, many new devices being exhibited. It was evident that in the near future more commodious quarters will be needed to accommodate the increasing number of exhibitors. As it was, too much praise cannot be given to the supply men for their fine exhibition and unvarying courtesy.

The list of exhibitors embraced the Adams & Westlake Company, American Arch Company, American Brake Shoe & Foundry Company, American Car & Foundry Company, American Steel Foundries Company, Angus Sinclair Company, Ashton Valve Company, Bowser Company, S. F., Carborundum Company, Chicago Pneumatic Tool Company, Crane Company, Celfor Tool Company, Coe Manufacturing Company, Crerar Adams & Company, Crucible Steel Company, Dearborn Drug & Chemical Works, Detroit Lubricator Company, Dixon Crucible Company, Emery Pneumatic Lubricator Company, Franklin Railway Supply Company, Galena Signal Oil Company, Garlock Packing Company, Goldschmidt Thermit Company, Greene, Tweed & Company, Griffin Wheel Company, Grip Nut Company, Hewitt Supply Company, Hunt-Spiller Manufacturing Corporation, Independent Pneumatic Tool Company, E. S. Jackman & Company, Jenkins Brothers, H. W. Johns-Manville Company, Keystone Lubricator Company, The Leslie Company, Locomotive Improvement Company, Locomotive Superheater Company, Manning, Maxwell & Moore, W. H. Miner, Monarch Pneumatic Tool Company, McCord & Company, Nathan Manufacturing Company, National Boiler Washing Company, National Machinery Company, National Malleable Casting Company, Niles-Bement-Pond Company, Oak Grove Handle Company, Ohio Injector Company, O'Malley-Beare Valve Company, Otis Steel Company, The Pilliod Company, Pittsburgh Steel Products Company, *Railway Age Gazette*, J. Ryerson & Son, Storrs Mica Company, The Watson Stillman Company, Westralian Rotary Spark Arrestor Company, Westinghouse Air Brake Company.

In conclusion we might add that the great and growing influence of the International Railway General Foremen's Association was apparent to every one. As the official organ of the association, Railway and Locomotive Engineering has endeavored to bring the association into public prominence and it was gratifying to observe that our booth at the convention was the center of intelligent activity during the entire period of the meeting. At the convention, Vice-president Scott, in an eloquent speech, moved that the special thanks of the association were due to our efforts and by a unanimous vote the publishers of the official organ were duly thanked for the space devoted monthly in promoting the interests of the association. We can assure the worthy officers and members that what we have already done is but an earnest of what we hope to do in the future. At the same time we are of opinion that much of the success of the association has been owing to the good sense that the members have shown in their choice of officers and committees. So long as they continue to choose men of the high caliber of the present executive staff, so long will the association flourish and grow in the estimation of all who are concerned in the welfare of railway men and the improvement of railway appliances.

Railroad Notes

The Minneapolis and St. Louis is reported to be in the market for 10 locomotives.

The Cleveland, Cincinnati, Chicago and St. Louis is in the market for 10 switching locomotives.

The Grand Trunk has ordered 15 switching locomotives from the Canadian Locomotive Works.

The New York, New Haven and Hartford has ordered 26 passenger cars from the Pullman Company.

The Central of Georgia Ry. has ordered 15 Mikado locomotives from the Baldwin Locomotive Works.

The Northern Pacific has ordered 10 switching locomotives from the American Locomotive Company.

The Chesapeake and Ohio has ordered 25 Mikado locomotives from the American Locomotive Company.

The Canadian Pacific, it is reported, have ordered 20 locomtives from the American Locomotive Company.

The New York Central Lines, it is reported, have ordered 20 locomotives from the American Locomotive Company.

The Northern Pacific Ry. has ordered 10 six-wheel switching locomotives from the American Locomotive Company.

The Southern Pine Lumber Company has ordered one six-coupled locomotive from the Baldwin Locomotive Works.

The Virginia Ry. is in the market for 12 locomotives. This is in addition to the order recently placed for 15 engines.

The Imperial Government railways of Japan have ordered 24 Mallet locomotives for the American Locomotive Company.

The Louisville and Nashville has ordered 12,000 tons of rails from the Tennessee Coal, Iron and Railroad Company.

The Denver and Rio Grande has decided to place orders for 16 Mallet locomotives, 14 Mikado locomotives, and 6 passenger locomotives.

The British Columbia Electric Ry., Vancouver, B. C., has ordered 22 electric interurban cars from the St. Louis Car Company, St. Louis, Mo.

The Baltimore and Ohio has ordered 1,000 steel underframes from the Ralston Steel Car Company and also 400 from the Pressed Steel Car Company.

The Cleveland, Cincinnati, Chicago and St. Louis, it is reported, has ordered 10 six-wheel switching engines from the Lima Locomotive Corporation.

The Litchfield and Madison has ordered 100 steel gondolas from the American Car and Foundry Company and is still in the market for a like number.

The directors of the Boston and Maine have appropriated $700,000 for increasing freight yard capacity and machine shop improvements at Mechanicsville, N. Y.

The Boston and Albany is in the market for 4,000 40-ton steel underframe box cars, 800 50-ton general service cars and 400 50-ton steel underframe flat cars.

The San Benito and Rio Grande Valley Interurban, San Benito, Tex., has been chartered in Texas to construct an electric line for a distance of 150 miles.

The length of railways in Brazil at the end of last year was 22,129 kilometers (13,750 miles), an increase of 758 kilometers (471 miles) over the total for 1910.

The Oregon Electric is reported as being in the market for 25 60-foot electric passenger cars and six 60-foot electric combination passenger and baggage coaches.

The Baltimore and Ohio has ordered 1,000 steel underframes from the Ralston Steel Car Company, and 400 steel underframes from the Pressed Steel Car Company.

The Grand Trunk has ordered 41 Pacific type locomotives from the Montreal Locomotive Works. They will be equipped with superheaters and will weigh 223,000 pounds.

The Pennsylvania has ordered 37 locomotives to be built at its Altoona shops for use on the lines East. This order is in addition to the 31 locomotives for the lines West, recently reported.

The Western Pacific is reported to have been incorporated in Oregon to build a road from Eugene, Ore., to Marshfield, and from the latter point to Eureka, Cal., a total distance of 240 miles.

The Southern is reported to have ordered 17,700 tons of 80-lb. steel rails from the Tennessee Coal, Iron and Railroad Company. This order is said to be in addition to those recently reported.

The Chicago, Milwaukee and St. Paul has ordered 50 Mikado locomotives, 10 consolidation locomotives and six Mallets from the American Locomotive Company. All of the above will be equipped with Schmidt superheaters.

The Erie Railroad has ordered 25 steel underframe electric lighted suburban coaches and 11 steel underframe combination passenger and baggage cars, equipped with electric lights, from the Standard Steel Car Company.

The Canadian Pacific Ry. has ordered 25 10-wheel superheater locomotives with 21 by 28 in. cylinders, driving wheels 63 ins. in diameter and a total weight of 198,000 lbs. in working order, from the American Locomotive Company.

The Wm. B. Pierce Company, manufacturers of the Dean boiler tube cleaner, have removed to more commodious quarters at 49 North Division street, Buffalo, N. Y. Their new improved boiler cleaner is met with much popular favor.

The Great Northern has awarded contracts in Washington as follows: For the rebuilding of the main line between Interbay and Metum, a station a few miles north of Ballard, involving an immediate expenditure of more than $1,250,000.

The Vulcan Iron Works, Wilkes-Barre, Pa., have recently opened a branch office at 913 McCormick Building, Chicago, Ill. The company's varieties of high-class locomotives, especially for construction and switching service, continue to be in growing demand.

The Canadian Northern has ordered four Pacific locomotives, with cylinders 23 by 28 ins., driving wheels 69 ins. in diameter, and a total weight of 213,000 lbs., from the Montreal Locomotive

Works. These engines will be equipped with superheaters.

The Seaboard Air Line has ordered 10 passenger coaches, seven combination passenger and baggage cars and seven combination baggage mail cars from the Pressed Steel Car Company. The road has also ordered six dining cars from the Pullman Company.

The Canadian Northern has 852 miles of new lines under construction. Extensive harbor and terminal improvements are being carried out at Port Mann, B. C.; the plans have been approved and work is to be started soon on large terminal shops and yards.

The New York Central and Hudson River has ordered 20 six-wheel switching locomotives, with 21 by 28 in. cylinders, driving wheels, 57 ins. in diameter, and a total weight of 167,000 lbs., in working order, equipped with superheaters, from the American Locomotive Company.

The Denver and Rio Grande divided its recent car order as follows: 700 box cars to the Standard Steel Car Company, 350 gondolas to the Pressed Steel Car Company, 100 stock cars to the American Car and Foundry Company, and 50 cabooses to the Haskell and Barker Company.

The Illinois Central has ordered 20 superheater Pacific passenger locomotives, with 25 by 26 in. cylinders, driving wheels 75 ins. in diameter, and a total weight of 248,000 lbs. in working order, from the American Locomotive Company, and 50 Mikado locomotives from the Baldwin Locomotive Works.

The Chicago and Northwestern has contracted for 4,000 barrels of fuel oil a day, and it is said to be the intention of its operating department to use only oil-burning locomotives west of the Mississippi. It now has fifty of them in service. The Burlington system is also seeking a supply of this fuel.

It has been announced that the Union Terminal Company, composed of all the railroads that enter Dallas, which was recently organized at that city, will erect a $5,000,000 union passenger station, and will also install large shop, roundhouse, electric power and light plant and extensive terminal facilities.

The New York Central Lines are said to have ordered 10 six-wheel switching locomotives from the Lima Locomotive Corporation and 10 similar locomotives from the American Locomotive Company. The orders are in addition to the 10 switchers ordered by the Cleveland, Cincinnati, Chicago and St. Louis.

More than 1,500 men are now employed on the construction of the line of the National Railways of Mexico to run between Tampico and Vera Cruz, with a branch line to a point on the old Honey road, the latter piece of construction to form a new short line between this port and the capital of the republic.

The Chesapeake and Ohio Ry. pier at Newport News, Va., was divided between the Pennsylvania Steel Company and the Virginia Bridge and Iron Company. The former received 5,500 tons and the latter 800 tons. The road also ordered 800 tons of steel tank plates from the Des Moines Bridge and Iron Company.

The Baldwin Locomotive Company has received another large contract from the Japanese Government, calling for 18 locomotives of the Mallet type. These engines will have a double set of cylinders and will be the largest in the world. Alba B. Johnson, president of the locomotive works, has announced that the engines would be ready by the first of October.

Receivers of the Pere Marquette have authorized the purchase of 5,000 tons of 90-lb. steel rails, making 6,000 tons in all, ordered within the past 60 days. The Southern has placed an order with the Tennessee Iron and Coal Company for 16,000 tons of rail and 9,000 tons with Maryland Steel Company. Grand Trunk Pacific has bought 10,000 tons from the Illinois Steel Company.

The reports of the mail service, baggage and day coach on the Central Railroad of New Jersey continue to bid fair to set a high-water mark of railroad travel. New York to Philadelphia, 90.2 miles, being daily traversed in 83 minutes, counting three minutes to change engines. From New York to Baltimore, 184½ miles, in 171 minutes. This is a little ahead of the Wolverine's 109 miles in 104 minutes.

It is understood that the Harriman lines have practically closed for 3,000 cars, the Duluth, South Shore and Atlantic is said to have placed orders for 1,000 cars, and the Denver and Rio Grande for 1,500. These orders will call for 55,000 tons of steel, and as already noted, the Grand Trunk has closed for 2,000 cars. The St. Paul is in the market for 700 to 1,000 cars, and the Boston and Maine for over 4,000 cars.

The Erie Railroad, it is reported, has ordered 45 superheater Mikado locomotives, with cylinders 28 by 32 ins., driving wheels 63 ins. in diameter, and a total weight of 320,000 lbs. Thirty of these were ordered from the American Locomotive Company and 15 from the Baldwin Locomotive Works. In addition to

the above the Erie Railroad is said to have ordered 10 Mikado locomotives from Lima Locomotive Corporation.

Railroad construction progressed very materially during 1911 on the 20 lines under construction for the Chilean Government, covering 1,580 miles, to cost $56,580,331 United States gold when completed. At the close of the year rails were laid on about one-half of these new lines. Five of the lines are to be completed and opened for traffic during 1912. During the year 8,500 persons were employed on the several works.

Vice-President O'Brien has issued a statement that during 1910 the Harriman system carried 49,491,000 passengers without sacrificing a single life. He attributes this to the installation of the block signal system, to surprise tests, and the Board of Inquiry system, under which officers of the company, working hand in hand with citizens, investigate accidents and impartially determine the cause and responsibility therefor, with full publicity given the findings of such boards.

The Denver and Rio Grande has just given out particulars regarding the budget for the current year. Among the items orders for sixteen Mallet compound locomotives of the articulated type were given the American Locomotive Works of Schenectady, N. Y., and the Baldwin Locomotive Works of Philadelphia received an order for fourteen Mikado type freight locomotives. An additional order for six passenger locomotives will be placed within a short time and also a contract for 700 box cars, 350 coal cars, 100 stock and 50 cabooses.

An important change in the operation of railroads west of the Missouri River has been announced as a result of the discovery of large oil fields in Wyoming, Utah and Colorado. The chief men of various large systems have tested oil-burning locomotives and have concluded that it is worth while to use this fuel on a large scale. The new Hill line from Seattle to Galveston passes through the large field at Caspar, which is now producing oil at the rate of 3,000 barrels a day, and it is understood that oil-burning locomotives will be installed on the route.

The latest effort to meet public opinion is the creation by the Chicago and Northwestern of a central smoke inspection organization. It is to make a determined fight to eliminate the smoke nuisance in Chicago. The department is to be in charge of Mr. C. W. Corning, as chief smoke inspector, and will co-operate with a like department established by the city to obtain maximum efficiency of fuel with a minimum of smoke from locomotives and shops. Mr. Corning has been provided with a staff of skilled subordinates who will instruct engineers and firemen in their duties.

The Wabash Railroad is one of the latest of the great systems to adopt selective telephone train dispatching. Its telegraph department has made a careful study of the operation of telephone dispatching on other roads and has recently placed an order with the General Railway Equipment Company, of New York and Chicago, for the equipment with the United States Electric Company's Gill selective system of telephone dispatching of about one-quarter of its lines. The five circuits cover over 600 miles, and the selective outfits, which number 146, are now being installed.

The proceeds of the $35,000,000 guaranteed by the Canadian Government to build the section of the Canadian Northern from Montreal to Port Arthur are in the bank and 7,000 men are at work hurrying forward this stretch to completion. From fifteen to twenty thousand men are at work from ocean to ocean, and the construction pay roll amounts at present to the sum of $5,000,000. The reports from the Pacific slope construction camps state that 320 miles east of the port of Vancouver will be completed by the first of next year, and with 260 miles of steel east of Edmonton at the same date there will then only be a gap of 150 miles left uncompleted early in 1913.

An English syndicate is responsible for the aërial railway to connect Manizales with Mariquita, but the planning of the line is in the hands of a German engineering firm, and was begun in January last. The distance to be covered is approximately 40 miles, not including a branch which will run from El Zancudo to the mining district of the same name. The greatest height at which the cable will be carried is 10,600 feet, in the neighborhood of La Leonera. For every mile of cable it will be necessary to construct 15 or 16 towers. The motive power is to be derived from a point on the River Guali, where, it is said, 750 horsepower can easily be developed. It is estimated that such a railway could transport 500 tons in 24 hours, and as construction expenses are relatively light the enterprise is regarded as very promising. Stations have been fixed at, among other places, La Elvira, Soledad, Fresno and Santa Ana.

Contentment.

If you see a man happy, as the world goes, contented with himself and contented with what is around him, such a man may be, and probably is, decent and respectable; but the highest is not in him and the highest will not come out of him.

Books, Bulletins and Catalogues

Letters from an Old Railway Official.

Under the heading of "Letters from an Old Railway Official," by Mr. Charles De Lano Hine, the Simmons-Boardman Publishing Company, New York, has issued a second series of these "Letters" in a handsome volume of 232 pages. As we stated in a previous notice of the author's work, he shows a ready familiarity with the details of the operating department of railways, and if the author, who has some ability, would content himself by abiding with railway matters his work would be of more interest and value to railway men. The military, political and social portions of his work could well be spared or kept in camera for the benefit of the imaginary son. The work, however, will well repay a perusal and, coming as it does at a time when reorganization and scientific management, like a pair of thumbscrews, are bending themselves to get every drop of blood out of those who live and move and have their strenuous being in railways, it cannot fail to attract attention. The book is finely printed and substantially bound. Price, $2.

Forney's Catechism.

The Simmons-Boardman Publishing Company, New York, has just published the second part of the new edition of Forney's Catechism in a fine volume of 292 pages. The work is sold at $3, or at $5 for both volumes. The revising and enlarging of the work has been done by Mr. Geo. L. Fowler, the eminent mechanical engineer, and his name is a good guarantee that the large amount of new matter contained in the volume amply sustains the high character of the work in the previous editions. Taking the work as a whole, however, we doubt if it will meet with the same popular favor. There is a redundancy of work in the volume that, while it is valuable of its kind, is valuable only to the select few. Mr. Forney's outstanding merits as an author was in his simplicity and clearness. His successors have brought a profusion of learning that is more academic than of every day use. The applicability of much of the work is doubtful to the ordinary mechanic, and the learned engineers have other works. The work, as a whole, however, is among the best of its kind, and we will be surprised if it does not meet with a certain measure of popular favor.

Reactions.

A quarterly publication devoted to the science of aluminothermics and issued by the Goldschmidt Thermit Company, New York, is growing in interest in each successive publication. Dr. Hans Goldschmidt's recent visit to America has increased the interest in the science of which he was the inventor. During his visit he repeatedly expressed his agreeable surprise at the quickness with which American engineers took up the process of thermit welding. It may be truly said that it is no longer an experiment. The present issue of the company's publication bears ample testimony to the great and growing popular favor which the important process is receiving.

Superheated Steam.

The Locomotive Superheater Company, New York, has just issued a 24-page illustrated bulletin on the application of superheated steam to the locomotive. A condensed report of numerous tests briefly illustrate the efficacy of the use of superheated steam, and it is gratifying to learn that the difficulties that were encountered at the early use of the improvement in the use of superheated steam have now been entirely overcome. All interested should secure a copy of the new bulletin.

Chambers Throttle Valve.

Catalogue No. 86, describing the improved Chambers Throttle Valve, has just been issued by the Watson-Stillman Co., 50 Church street, New York. This valve is said to be superior to the ordinary throttle valve in the following particulars: A single seat, regrinding without removal, no lost motion, internal boiler inspection without removal, takes dryest steam from highest point in dome, perfect balance, easy operation and screw or level control.

Vanadium Steels.

The Vanadium Sales Company of America, Pittsburgh, has just published an 80 page booklet giving complete and up-to-date information on a variety of experiences with vanadium steel. The work embraces full details of various types, compositions, heat treatments and tables of tests. The information contained in the publication is of much value to engineers and others interested in steel and iron products. Copies may be had on application.

Sparks and Spark Arresters.

Mr. Cyril S. Garton, C. E., general manager of the "Westralian" Improved Rotary Spark Arrester Company, has just published an elegant bulletin descriptive of the new and important device. In addition to the descriptive matter there are half a dozen fine illustrations, and the work altogether furnishes a very complete description of the invention. The invention has already met with the warm-

est approval from the most eminent authorities. All who are interested in spark arresters, with a view to the complete suppression of fires from locomotive sparks, should send for a copy of the bulletin to the company's American office, 42 Broadway, New York.

Hydro-Pneumatic Wheel Presses

Catalogue No. 85, illustrating three types of Hydro-Pneumatic Wheel Presses and listing and describing over 70 variations in type and size of from 60 to 600 tons' capacity, has just been published by the Watson-Stillman Co., 50 Church street, New York City. The hydro-pneumatic feature in wheel presses is exclusive with this company. A copy will be sent to any one interested.

Insulated Transformers.

Descriptive Leaflet 2496, issued by the Westinghouse Electric & Manufacturing Company, describes their outdoor type, oil insulated self-cooling transformers. These transformers are of the same construction as those built for indoor service with the additional features necessary for installation outdoors. The leaflet describes the details of construction and shows several views of outdoor installations.

A. R. T. F. Association.

The American Railway Tool Foremen's Association held its fourth annual convention at the Hotel Sherman, Chicago, Ill., July 9, 10 and 11. The attendance and the successful manner in which the well-arranged programme was carried out strongly indicate the growing interest that is being taken in the work of this association. This organization is calculated to do a valuable work in educating both the toolroom foremen and their superior officers to the importance of the tool department. It seems that the association is receiving much encouragement from superintendents of motive power and master mechanics, and this will aid substantially in its growth.

Bridgeport Chain Company.

A rumor is being circulated that the Bridgeport Chain Company has been absorbed by another corporation, which is in a similar line of business. Such information is without any foundation whatever. The control of the Bridgeport Chain Company has not passed into other hands, but is still under the same careful management which it has been for many years. The company's facilities for economical production are greater today than ever and the amount of business is constantly increasing.

A Wise Whale.

"I'm afraid I'll disagree with you," remarked Jonah as the whale swallowed him.

"Perhaps," replied the whale, "but it won't be a circumstance to the way the theologians will disagree when they come to discuss this incident."

Epitaphs.

If all would speak as kindly of the living as in epitaphs they do of the dead, censorious gossip would soon be a stranger in the world.—*Bulwer.*

Knew About Hobson.

Representative Hobson, of Merrimac, Jap war scare and other fame, was riding toward Washington the other day when a stranger, accompanied by a small boy, moseyed over to him and inquired:

"You're Captain Hobson, aren't you?"

"Yes," admitted Hobson.

"Well," said the man, "if you have no objections I'd like to introduce my little boy to you. I think it would help him with his American history to meet a war hero."

So Hobson obligingly acquiesced.

"And now," the fond father asked the boy, "let's see if you can remember what it was that Captain Hobson did."

"I know," asserted the lad. "He's the fellow that blew up the *Maine.*"—*Cleveland Plain Dealer.*

Made Him Listen Again.

The late A. L. Williams, of Topeka, general attorney for the Union Pacific, was once on a trip with a party of friends in a private car. While in Denver one of the party, a man of convivial habits, came in the car late one night and found Mr. Williams playing solitaire. The convivial one was enough under the influence of liquor to be talkative and proceeded to tell Mr. Williams a long story of his domestic unhappiness. The next morning, when sober, he mentioned the fact that he had talked too much the night before and requested that anything he might have said would not be repeated. Mr. Williams, in order to relieve the man's embarrassment said: "That's all right; I never listened to you and have no idea what you said."

That night the man returned in the same condition. Looking sternly at Mr. Williams he said:

"Now, durn you, you said you didn't listen to me last night, so I'm going to tell you the whole story again, and you've got to listen."—*Kansas City Star.*

Whatsoever of morality and of intelligence; what of patience, perseverance, faithfulness, of method, insight, ingenuity, energy; in a word, whatsoever of strength the man had in him will lie written in the work he does.

Easier on Trunks.

The Cumberland Valley Railroad has introduced a novelty in the shape of a cushion for unloading baggage from trucks in baggage rooms. It has already proved very efficacious in protecting trunks. The mat or cushion is 4 ft. 4 ins. long by $22\frac{1}{4}$ ins. wide, and consists of four strips of hard wood 4 ins. wide by 4 ft. 4 ins. long, across which are nailed twenty-four pieces of scrap air hose. The hose is held in place by $1\frac{1}{2}$ in. clout nails driven through the bottom of the slats and clinched to the hose by means of an iron rod inserted while the nails are being driven. The universal adoption of the device would be quite a blow to the trunk industry.

The Irish Names.

Shure the Railway Pay Rolls have a rollicking ring to thim;
They have names with body and bones and a soul to thim,
Shure and they're poethry, Darlint Asthore,
Names wid the smell of the praties and wheat to thim,
Names wid the perfume of whiskey and peat to thim,
Names wid the smell of the sod hangin' sweet to thim,
Where can yez bate thim, the whole world o'er?
Brannigan, Flannigan, Milligan, Gilligan,
Ryan, O'Brien, Mularky, Muldoon,
Rafferty, Lafferty, Connelly, Donnelly,
Quinlan and Quigly, Murphy, Magoon,
Hallahan, Callahan, Flaherty, Dougherty,
Hagan, O'Fagan, O'Houlahan, and Flynn,
Lanahan, Shanahan, Hogarty, Fogarty,
Kelly, O'Skelly, McGinnis, McGinn.
Names wid a fine old Hibernian hue to thim,
Names wid the shamrocks dripping wet wid the dew to thim,
Shure and they're elegant, Darlint Asthore,
Names wid the winds of the Green Isle singing soft to thim,
Names wid the taste of the salt o' the earth to thim,
Names wid the blood of the land o' their birth to thim,
Where can yes bate thim, the whole world o'er?

In all things throughout the world, the men who look for the crooked will see the crooked, and the men who look for the straight will see the straight.

The maxim on which I have acted and the maxim which I have often commended to my friends is—Be a boy as long as you can.

Lima Locomotive Corporation.

The Lima Locomotive Corporation has sold to Redmond & Co. the entire issue of \$2,000,000 first mortgage 6 per cent. 20-year sinking fund gold bonds, callable in all or in part at 110 on any interest date. Proceeds will be used for the erection of additional buildings, purchase of equipment, and for working capital. The new plant will provide employment for 4,000 men.

This company, recently organized, has taken over the Lima Locomotive & Machine Co. For many years the latter company manufactured only geared locomotives, but during the past ten years steadily increased its output of railroad locomotives of all classes until further extensions have become necessary. The new corporation owns 43 acres of land at Lima, Ohio, on which there is a modern plant, having a capacity of 400 engines per annum. This capacity will be increased to 900 or 1,000 locomotives a year. The net earning for the past seven years, after deductions for depreciation, have averaged $2\frac{1}{3}$ times the interest on the new bonds.

The directors are A. L. White, Ira P. Carnes, W. T. Agerter, G. L. Wall, O. J. Thomen (of Redmond & Co.), and Merle Middleton. The company will be under management of the same official staff as heretofore, A. L. White, president; G. L. Wall, vice-president; W. T. Agerter, secretary and treasurer; Merle Middleton, chairman of the board.

Horsepower and Grate Area.

There has been considerable conflict of opinion among scientific engineers concerning the amount of grate area of a locomotive required to generate steam for every horsepower developed. A statement was once made at a railway club meeting that certain locomotives were capable of developing one horsepower for each square foot of grate area. That statement was contradicted by Dr. Goss who insisted that it required from one and a half to two feet of grate area to generate steam for one horsepower. As the experience of Dr. Goss has been mostly with experimental locomotives operating on a stationary plant the data obtained may be interesting. The writer has indicated a locomotive with 27.3 square feet of grate area which developed 1,120 horsepower.

When one is very young, and when one is very old, one prefers books to people; before you know much of life, and after you know it all.

No man would feel himself alive if he did not have adversaries.

If you want things done, call a busy man—the man of leisure has no time.

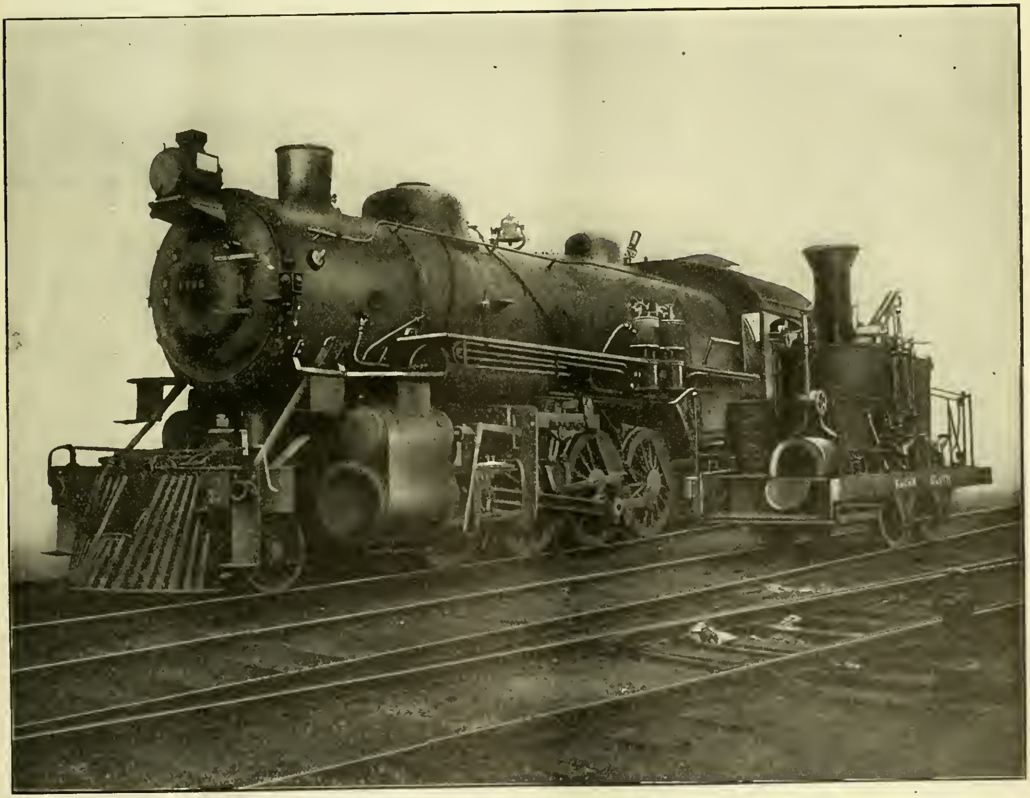
Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXV. 114 Liberty Street, New York, September, 1912. No. 9

The Baltimore & Ohio Railroad.

The history of the Baltimore & Ohio Railroad is in many respects the history of railroading in America. True, it was not the first railroad built in America. It was preceded by a railroad three miles in length at the granite quarries at Quincy, Mass., and by several other small branches in other parts of the country, but the Baltimore & Ohio was the first road of any considerable length, and the first locomotive constructed in the United States was run on this road on August 28, 1830. This was nearly a year after Stephenson's triumph in England, but no British built locomotive had yet reached America, and Peter Cooper built a small locomotive that successfully made a trip on the date referred to. The company from its inception has always shown a readiness to try any experiment looking towards improvement in railroad traffic, and also ever ready to make full and complete reports of their triumphs or failures. They were the first to attempt hill climbing and sharp curving, and as the work progressed and heavier equipment was introduced, distinguished foreigners visited America for the purpose of inspecting the means and methods in use on the enterprising railroad. This spirit was kindled among the American railroads generally, and hence a complete departure from European methods began, and successfully continued with the result that in point of power and thoroughness of equipment America leads the world in almost everything relating to railroad operations.



ANCIENT AND MODERN MOTIVE POWER ON THE BALTIMORE & OHIO RAILROAD.

From Peter Cooper's steam wheelbarrow to the 240-ton locomotives of today is a long step, and it is interesting to pass

in review the mechanical makeshifts, the engineering absurdities, the childlike errors, and the grotesque forms through which the ever active spirit of enterprise groped its way to perfection. They that endure overcome, and surely in this case perseverance has had its royal reward. From 1830 to 1850 the road had extended from 14 miles to 200 miles. In 1853 the road was completed from Baltimore to Wheeling, 379 miles. While progress had been made in railroading all over the Eastern States, nothing had been attempted at all comparable to the tasks successfully accomplished on the Baltimore & Ohio. Grades 530 ft. to the mile, a fraction over 10 per cent., had been climbed without any assistance outside of the smooth-tired wheel.

In 1831 prizes were offered by the company for the best American made locomotives. The firm of Davis & Gartner, York, Pa., was the winner. The locomotive was 3½ tons in weight, and hauled 15 tons at an average speed of 15 miles per hour. A larger locomotive followed from the same firm, and both were anthracite burners. They had upright tubular boilers and were carried on four wheels, as shown in the frontispiece illustration. The boiler was 51 ins. in diameter and 69 ins. in height above the grate. There were 282 flues. The stack was 13 ins. in diameter and 14 ft. 6 ins. above the rails. Cylinders 10 by 20 ins. Wheels 35 ins. in diameter. The driving wheels were geared to a larger gear wheel driving by a single piston. A fan blast was used in aiding combustion. The steam pressure was 50 lbs., and the cost of the locomotive was $4,500. The first double engines appeared in 1834, and were of the "grasshopper," or beam, type. These were followed by the "crab" type, the boiler and general equipment being the same with the exception of the cylinders which were placed horizontally, the motion being conveyed, as formerly, from the engine to the running wheels by intermediary spur gearing. Latterly a cab and tank were attached to the "crabs." After these curiosities came a new class, some of which were furnished by William Norris and others by Matthias W. Baldwin. These were furnished with horizontal boilers and swivel trucks. By and by the four fixed eccentrics appeared, and also the spark arrester. The reverse gear was of the drop hook type, and presently the equalizer came simultaneously with the 4-4-0 type of locomotive, and by 1840 some approach to the modern type of locomotive began to appear.

STEAM AND ELECTRIC LOCOMOTIVES AT WORK ON THE B. & O.

It was singular that after the horizontal cylinders had been in use for some time, the method of elevating the cylinders came into vogue. The idea that this peculiar form added to the tractive force of the engine lingered a long time, but in 1853 a master builder of locomotives appeared in America in the person of William Mason, who began building locomotives at Taunton, Mass., in 1853. At this time Henry Tyson was master of machinery of the Baltimore & Ohio Railroad, and it was largely through his instructions that Mason then introduced what may properly be called the modern American locomotive. The designs embraced the telescope boiler, in place of the old dome pattern, horizontal cylinders secured to the frame, cylinder saddles, and an adaptation of the perfected shifting link motion.

Meanwhile Ross Winans, an eminent engineer in the employ of the Baltimore & Ohio Company, had been experimenting in locomotive construction on lines peculiarly his own. From his ingenious hands six and eight-wheeled locomotives appeared. The engines proper were set above the frames, driving a separate axle, the motion of which was transferred to one pair of driving wheels, and by means of cranks and connecting rods to the

SUSQUEHANNA RIVER BRIDGE, BALTIMORE & OHIO RAILROAD.

other wheels. Finally the cylinders were lowered to the same plane as the centers of the axles, and the perfected eight-wheel locomotive appeared. These were the most powerful and best constructed locomotives that appeared for many years in America. Other varieties came from Winan's clever hands, and the rivalry between Mason's and Winan's resulted not only in variety of design, but in fanciful ornamentation that made the locomotives of the Baltimore & Ohio the admiration and wonder of the people along the roads they traversed, and it may be added that while this seems grotesque to us, it must be remembered that the feeling towards the introduction of the steam locomotive was not kindly, either in Europe or America; the vari-colored wonders of the locomotives to which we refer did much to effect a spirit of reconciliation towards the innovation by presenting an appearance at once gorgeous and spectacular.

Out of the general and growing desire for heavier motive power the first of the Moguls, or 2-6-0 type, appeared in the 60's, and the earlier types began to vanish. There was also less paint and gilding and more tractive power, and indeed it may be justly said that whatever was strongest and heaviest in motive power was almost sure to be first seen on the Baltimore & Ohio. This may properly be said to have culminated with the introduction a few years ago of the Mallet articulated compound type, which, though of French invention, appeared in America in proportions beyond anything dreamed of in Europe. Coincident with their appearance also came the first of the larger class of electric locomotives, so that the same spirit of encouraging whatever is new and advanced in motive power is still as dominant as ever in the minds of the master spirits of the Baltimore & Ohio railroad.

It need hardly be added that the great roadway has kept pace with the progressive spirit of the age. Reaching, as it does, from the Atlantic to the Great Lakes, and from Chesapeake Bay to the Mississippi River, it may be said to pass through the richest parts of half of the American continent. With its branches it extends to 3,500 miles in length, and has over 2,000 locomotives in service, with 97,000 cars.

The Baltimore & Ohio Railroad Company has been fortunate in the ability of its executive officers, but we do not think it ever has had a manager equal in ability to the present president, Daniel Willard. A person or a corporation having an illustrious past is nearly always contented to rest and be thankful thinking that good fortune is always assured. That sentiment may be fatal to enterprise, and no doubt tended to lead some managers of the Baltimore & Ohio into slow moving ruts which curtailed fields of enterprise. Mr. Willard was the proper man to pull the property under the influence of modern methods, and we have ceased to see Slow and B. & O. placed in satirical rhyme.

Railways of the United States.

The Interstate Commerce Commission has published for the press, a statement giving statistics of railways in the United States for the year ending June 30, 1911, from which we extract the following facts:

MILEAGE.

Substantially complete returns were rendered to the Commission for 246,124.40 miles of line operated, including 11,006.86 miles used under trackage rights. The aggregate mileage of railway tracks of all kinds covered by operating returns was 362,710.18 miles. This mileage was thus classified: Single track, 246,124.40 miles; second track, 23,451.26; third track, 2,414.16; fourth, fifth, and sixth tracks, 1,747.10; yard track and sidings, 88,973.26. These figures indicate an increase of 10,943.59 miles over corresponding returns for 1910 in the aggregate length of all tracks, of which increase 3,391.33 miles, or 30.99 per cent, represent yard track and sidings.

EQUIPMENT.

It appears that there were 61,327 locomotives in the service of the carriers on June 30, 1911, indicating an increase of 2,380 over corresponding returns for the previous year. Of the total number of locomotives, 14,301 were classified as passenger, 36,405 as freight, and 9,324 as switching, and 1,297 were unclassified.

The total number of cars of all classes was 2,359,335, or 69,004 more than on June 30, 1910. This equipment was thus assigned: Passenger service, 49,818 cars; freight service, 2,195,511; and company's service, 114,006. The figures given do not include so-called private cars of commercial firms or corporations.

It appears that the average number of locomotives per 1,000 miles of line was 249, and the average number of cars per 1,000 miles of line was 9,586. The number of passenger-miles per passenger locomotive was 2,268,067, and the number of ton-miles per freight locomotive was 6,913,246.

The returns indicate that the number of locomotives and cars in the service of the carriers aggregated 2,420,662, of which 2,391,438, or 98.79 per cent, as against 97.96 per cent, in 1910, were fitted with train brakes, and 2,409,973, or 99.56 per cent, as against 99.30 per cent, in 1910, were fitted with automatic couplers. Of the 2,195,511 cars in freight service on June 30, 1911, the number fitted with train brakes was 2,180,301, and the number fitted with automatic couplers was 2,186,233.

EMPLOYEES.

The total number of persons reported as on the pay rolls of the steam roads of the United States on June 30, 1911, was 1,669,809, or an average of 678 per 100 miles of line. As compared with returns for June 30, 1910, there was a decrease of 29,611 in the total number of railway employees. There were 63,390 enginemen, 66,376 firemen, 48,200 conductors, 133,221 other trainmen, and 40,005 switch tenders, crossing tenders, and watchmen.

The total number of railway employees (omitting 93,718 not distributed) was apportioned among the six general divisions of employment as follows: To maintenance of way and structures, 493,926; to maintenance of equipment, 344,112; to traffic expenses, 22,246; to transportation expenses, 629,654; to general expenses, 52,201; and to outside operations, 33,952.

The complete report will include summaries showing the average daily compensation of 18 classes of employees for a series of years, and also the aggregate amount of compensation reported for each of the several classes. The total amount of wages and salaries reported as paid to railway employees during the year ended June 30, 1911, was $1,208,466,470.

Weight of Trains.

The extreme weight and speed of modern railway trains is a train weighing 400 tons moving at a velocity of 75 miles an hour. Many people are amazed at the destruction effected by railway trains when they strike an object at rest, such as a delayed train. A train moving at the rate of 75 miles an hour passes over 110 feet per second. A mass of 400 tons propelled at that rate of speed contains energy nearly twice as great as that of a 2,000-pound shot fired from a 100-ton Armstrong gun. No wonder that such a train proves a terribly destructive projectile.

Ready for the Harvest.

Many farmers in the West are building sheds in which to store the wheat, and some of them are building tanks. In some of the districts less than half the usual quantity of wheat has come to market, and elevator companies and railroad men are perturbed by the "strike." They had made arrangements to handle double the quantity of wheat that has come in. Meanwhile all the granger railroads are making vigorous efforts to have every car they possess ready for business as soon as the rush comes. Shortness of car repairers is a plaint heard far and wide.

General Correspondence

Heating Surface Per H. P.

Editor:

In your issue for August I note a brief item entitled "Horsepower and Grate Area," in the course of which I am quoted as insisting "that it required from one and one-half to two feet of grate area to generate steam for one horsepower" in locomotive service, and other statements to the same general effect. Since the writer of this item has evidently confused grate area with heating surface, the following may be of interest:

The best result obtained upon the Purdue testing plant for a considerable number of years after its establishment was a horsepower for each 2¼ ft. of heating surface. This rate has since been exceeded at the Purdue plant and upon the locomotive testing plant of the Pennsylvania Railroad Company. In recent tests of a Jacobs-Shupert locomotive boiler at Coatesville, Pennsylvania, 1,669 boiler horsepower was developed from 3,008 ft. of heating surface, or a horsepower for each 1.8 ft. of heating surface. The grate area of this boiler is 56.8 ft., so that 29 horsepower was developed per ft. of grate area. So far as the undersigned is informed this represents the record to date.

W. F. M. Goss.

University of Illinois,
Urbana, Ill., August 7, 1912.

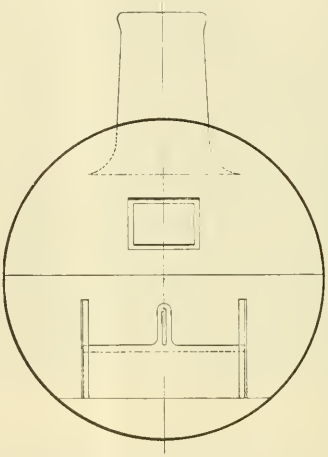
Front End Design.

Editor:

The enclosed drawing was made with special reference to an Emerson superheater, but can be used on any of the larger engines. I wish to object to it being called a "spark arrester," simply a front end designed to remedy the waste of fuel, the nuisance from fire, smoke and cinders by burning them in the firebox and creating real heat carbon dioxide gas. The specification for Mikado type engine, 27 ins. x 30 ins. cylinder, is a stack with choke at the exit; 17 ins. diameter at choke, 19 ins. at line of smokebox, an extension in smokebox 12 ins. with 24 ins. flare. The nozzle, an even taper, no bridge or obstructions of any kind to deflect the exhaust. Tip of nozzle 7 ins.

Diaphragm plate all in point of steam pipes and giving an area behind it equal to the area in front, thereby giving equal draft through all the flues. The plate to have extended wings with angle irons for the slide plate and the plate to have a central extension with a slot and bolt for adjustment.

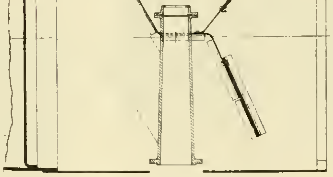
Rule for setting and adjusting: Set the plate at a point equal in area to largest portion of stack and if engine tears the fire at front part of firebox or throws any live spark lower the plate until the fire burns strongest under the door.



FRONT END DESIGN.

Note that this is opposite to the rule usually given for this trouble and that the stack is virtually an inverted bottle.

To write an explanation of this in complete form I would have to go into geology, chemistry and mechanical laws of forced draft in the locomotive, and if there is a committee of the M. M. A. that would be willing to take the matter up personally, I would be pleased to explain why it is that for every dollar's worth of coal we use about 25 cents' worth of steam goes to the cylinders and 75 cents' worth goes up the stack, and also why a great many of our engines have back pressure and compression equal to mean effective pressure.



FRONT END DESIGN, SHOWING IMPROVED DIAPHRAGM.

J. A. Eson.

Denver, Colo.

Interstate Commission Reports.

Editor:

As per our conversation, I take pleasure in writing you that the Interstate Commerce Commission issues a preliminary abstract of statistics of common carriers, whose last issue was for the year 1911. In the operating statistics the various costs are given for the locomotives, repairs, renewals, depreciation, etc. Freight and passenger cars, work and special service cars, and in fact all railway equipment costs are shown. In addition the total number of revenue passengers, total number of revenue passenger miles, average distance carried per passenger (miles), average revenue per passenger, average revenue per passenger mile, passenger service train revenue per train mile, and the freight expenses are shown under similar headings. This all serves to show that computations of revenue and expense are being figured on a mileage or ton mile basis, as well as the rates being established from the classification and average tons per car hauled per mile. While this adjustment of rates perhaps is the most difficult to determine, the mileage basis seems to be the most favored method in determining costs for various items in the mechanical department for repairs, renewals, etc. That the greatest earning may be obtained for the least expenditure the question has been agitated by mechanical men that in order to practice intelligent economy, it might be advantageous to have the larger items of repairs and renewals separated from the general account or subdivided in a manner that such items would appear under a cost per 1,000 mile basis.

While this would require time and might not meet the views of men operating equipment offered in interchange, it could be worked out on locomotives, passenger train cars, special service cars that are used on home line almost exclusively, and if found profitable could then be extended to cover other equipment. Take the item of wheels for any class of service, they could be purchased on a guarantee cost per 1000 miles. This

would not in any way interfere with the M. C. B. wheel specification or test, but would mean that the manufacturer would be required to produce a wheel that would give the greatest number of miles for the least cost, or in other words, the least cost per 1000 miles for wheels for the class of service designated.

This could be determined from such data as kind of wheel, date applied, date removed, initial cost, scrap value, miles made, cost per 1,000 miles. In the case of a steel tired or steel wheel that required turning when tread or flange were worn, the cost of removing, turning and replacing, and the cost of shimming bolster to maintain draw bar at proper height should be included in the cost per 1,000 miles and thereby determine the type of wheel best suited to the class of service desired. The same system could be extended to draft gears, couplers, or other large items and possibly prove of mutual benefit to the railway as well as the manufacturer.

M. P. VETERAN.

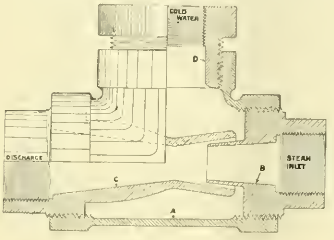
Hot Water Mixer.

Editor:

The drawing enclosed shows a home-made hot water mixer for locomotive boiler washout that can be made by any machinist in a short time, and with very little material. The main body A is a common 3½-in. T, and the piece B is made from a brass 1¾-in. pipe. This is the steam inlet. The piece C is the discharge end adapted for 2½-in. pipe, and the piece D is the cold water inlet adapted to suit a 2½-in. cold water union.

We have an extra water header combined with boiler for washout, and this hot water mixer we have connected in our piping, which serves as an emergency outfit when the header does not work, and the results are always of the best.

J. G. KOPPELL.
Montreal, Que., Canada.



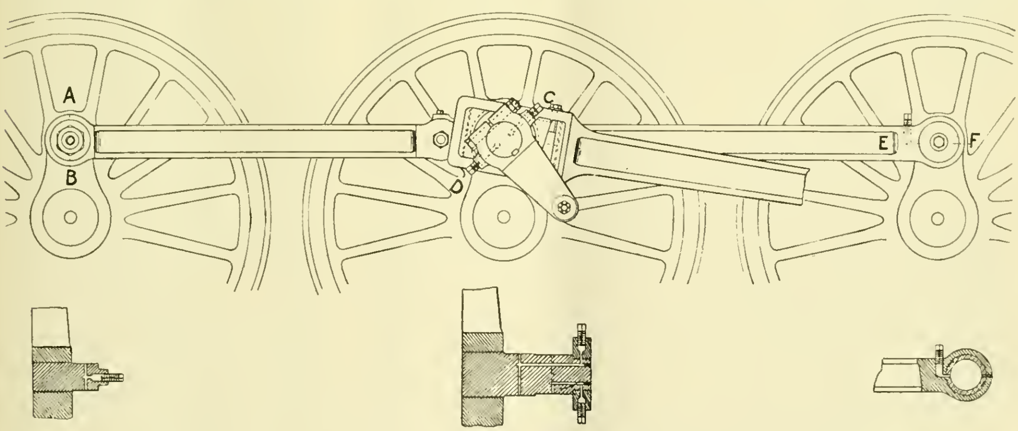
HOT WATER MIXER.

Crank Pin Lubrication.

Editor:

Attached print shows proposed method of lubricating crank pins. The object of this method is to do away with machine work on cups which are now forced on rods, rods will be simpler to forge and machine and will also be lighter. The loss of grease plugs on rods is now a great loss and will be prevented if applied as shown. You will note that the main and middle connection pins are lubricated by ¾-in. holes drilled from end of main pin and three ¼-in. holes drilled through pin bearing to meet the ¾-in. holes. Grease is applied to grease cups on both sides of Walschaerts crank arm. Back pin is lubricated by ¾-in. hole in center of pin and three ¼-in. holes in bearings to meet the ¾-in. hole. Grease is applied to grease plug opening tapped out in end of pin. The front pin is lubricated by hole tapped out in rod which is not channelled out so far back as to weaken it, ¼-in. hole is drilled through bushing to meet the grease plug hole in rod. Blue print plainly shows the method, and I believe it will be of interest to readers of RAILWAY AND LOCOMOTIVE ENGINEERING.

CHAS. MARKEL,
Shop Foreman, C. & N. W. Ry.
Clinton, Iowa.



IMPROVED METHOD OF CRANK PIN LUBRICATION.

Old Timers Wanted.

Editor:

Having been a reader of your magazine since its birth in 1888, I would like to ask you or any of your subscribers for a short history of the old Atlantic & Pacific Locomotive Works, of Jersey City, N. J., which, I am informed, was in existence in the late Fifties or early Sixties and was situated on Morgan, Stueben and Warren streets.

Your pictures of old-time locomotive engines are very interesting; and I would like to see one of the little engines and cars of the New York & Harlem Railroad as they appeared in the Seventies.

The Harlem cars were painted Paris-green with black letters. The New Haven cars were painted orange color with dark olive-green letter board and gilt letters, while the New Haven engines had more brass and red paint than any others on the Atlantic seaboard.

I remember one engine that had the wagon top and throat covered with brass.

For simplicity of machine design and "get there" quality I believe the engines of the Eighties outclassed those of today considering their size.

Evidently the locomotive machinists of which William Mason was one have become extinct, for very few engines of today show any originality or superior design.

F. H. SOMMER.
New York, N. Y.

Triple Slide Valve Grinding Device.

Editor:

Rule No. 60 of the M. C. B. Association provides that all triple valves are to be removed from cars for the purpose of cleaning and repairing; also that all triple valves after being cleaned and repaired be subjected to a series of tests on an M. C. B. triple valve test rack.

Test No. 2—section "A" and "B"—demands that the slide valve of triple valves be tight enough to hold a soap bubble placed over the exhaust port of triple valve.

Most triple valves after being in service for a number of years will not pass this test unless the slide valve is first ground into its seat. A limited number of slide valves need facing off on account of having elevation and depression, which, however small, must first be removed before the work of grinding in the slide valve may be commenced with.

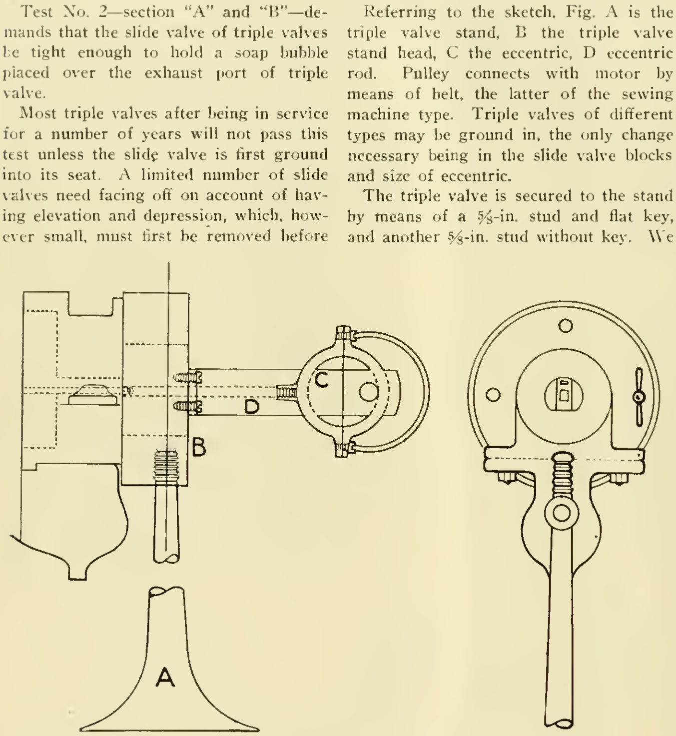
If this work is done by hand it is not only tedious, but requires considerable skill and a good deal of time, which ranges all the way from 15 minutes to one hour; and in some cases, plain triple valves and those of the "L" type, even more time is required.

In order to expedite this work we have constructed and put in operation a device as shown in the accompanying sketch by the use of which we can turn out better work and more of it. The truth of this assertion lies not alone in the fact that the device works a good deal faster and more steadily than could be done by hand, but is also due to the operator being able to grind in the check valve on the same motor, if so equipped, at the same time, and may also fit the triple piston packing ring to its bushing without in any way interfering with the grinding in of slide valve.

The device is very simple, inexpensive and is operated by means of a one-eighth horse-power electric motor. The speed should not exceed 300 revolutions per minute. At times it is desirable to run the device at a slower speed, and for this purpose we have inserted an electric current regulator which also answers as a switch.

Referring to the sketch, Fig. A is the triple valve stand, B the triple valve stand head, C the eccentric, D eccentric rod. Pulley connects with motor by means of belt, the latter of the sewing machine type. Triple valves of different types may be ground in, the only change necessary being in the slide valve blocks and size of eccentric.

The triple valve is secured to the stand by means of a ⅝-in. stud and flat key, and another ⅝-in. stud without key. We use Trojan grinding compound for grinding, mostly extra fine quality. To start the work the slide valve blocks are placed over the slide valve and then the whole is inserted into the slide valve bushing and rod D connected to the slide valve blocks and the lever of electric speed regulator placed in the proper position.



TRIPLE SLIDE VALVE GRINDING DEVICE.

At suitable intervals of time, the slide valve is easily removed from the triple valve by disconnecting rod D, then Trojan applied and replaced.

The combined pressure exerted on top of the slide valve of a P. H. I. triple valve by the two springs should be about 15 pounds. For larger slide valves stronger springs should be used.

FRANK J. BORER,
Foreman Air Brake Dept. C. R. R. of N. J.
Elizabethport, N. J.

Flange Lubrication.

Editor:

It is a most startling fact that, in almost one hundred years of railroad history, the frictional resistance of rail curvature has been given no attention. Every frictional part of a locomotive and car has been studied with all the practical and technical skill available. Exhaustive tests have been made of suitable oils for the purpose. Countless reprimands have been issued on the waste of oil per engine per mile, but not a thought seems to have been expended on flange lubrication.

At the recent Master Mechanics' convention, "Flange Lubrication" was one of the prominent subjects of discussion and interest. Also at the convention of 1911, the question gained the ear and attention of many of the mechanical department experts and officials. On a recent extended trip throughout the United States the writer met many railroad men whose positions do not entitle them to membership in the association, or at least they cannot find the time and other necessaries to enable them to associate at the convention city, but who are nevertheless vitally interested in all that may concern themselves and the systems with whose interests they are identified.

The subject of flange lubrication was apparently new on most systems and, although tests were being made on some roads of the various types of lubricators, the practical knowledge of the methods of application and the objects sought was almost a closed book to the man who is held responsible for the successful application and maintenance of flange lubrication.

The complaint was, "We hear, read and know of flange wear and, in an abstract way, of rail wear, but the real, practical knowledge of how and where to apply the lubrication to get results is not given us." And it is due to this lack of knowledge on the subject that the dilatory manner of application and attention to flange lubrication will surely contribute to the condemnation of one of the most beneficial antifrictional devices for railroads.

Millions of dollars have recently been expended on eliminating curves that in many cases do not shorten distance, from which we may deduce that the object sought was to reduce flange friction, or rather to enable greater speed to be maintained. If the latter, why should not the flanges and rails be lubricated to eliminate the danger of rail climbing. And if the former holds, the question of rail and flange lubrication will equally apply.

It has been recently, and is even now, the practice in running down grade to apply brakes on straight track and recharge on the curves. If there is paramount need of carefulness in handling a train, surely the greatest control is needed where the greatest danger exists, and the fact that rail and flange friction plays so important a function as being

used for braking purposes, only emphasizes the need of flange lubrication.

It is easy to imagine the effect of a long train on the engine on up grade where there is curvature and especially severe curvature. We are all familiar with the old illustration of a piece of string shown in curves, with the engine at one end and the caboose at the other, and the engine vainly trying to pull in a straight line. Still we doubt the efficiency of oil as a flange lubricant.

It is reasonable to suppose that, on account of the heavy load an engine is called upon to haul, the flanges are subject to much friction and that, when running light, the friction is very much reduced, showing that the rigid wheel base is not always all the cause of excessive driver flange wear.

A question which presents itself to those who have not had actual experience in the hauling of oil as a flange lubricant is: "Does not the engine slip a great deal when oil is used on flanges?" The answer is "no," that slippage cannot occur with the amount of oil used when applied to the proper place. A great part of the slippage on mountain grades is due to the rail being worn at the side so that insufficient surface is presented to the drivers for adhesion. As a result, we hear at times of engines being over-cylindered or that the throttle cannot be regulated. Various other diseases are mentioned to account for a rail whose surface dimensions have been reduced one-third of its original and careful design.

This condition of rail is especially hard on the mechanical department, and especially the master mechanic, whose lot happens to be cast on a mountain division. Curve derailments are common, frequently caused by the excessive friction of flange and rail. The Board of Investigation appears on the scene—the roadmaster to the wheels and the master mechanic to the rail—and between them it is a contest as to who can show the best side of the case.

The master mechanic is constantly watching the flange wear and restoring his tires only to have them on the same old rail to go through the process even faster than before. After the rail has reached the condition where it cannot be further used on the main line, it is turned about and used on passing tracks, where it is often a question whether the train will get past, owing to the small surface presented to the wheels or driver for adhesion. And after the grind on the narrow rail, it is easily seen what the result must be when the engine resumes its course on the perfect rail surface. But it is not enough to look at the cut flange on the forward pair of drivers and presume that the trouble and expense entailed by flange friction end there. The renewal and changing of driver tires is really one of the smallest items in the consideration of oil as a flange lubricant. The large number of tender truck and engine truck wheels is a greater item.

Rail wear is possibly greater than these items combined. Detention of power for these flange renewals is a costly and an annoying source of the master mechanic's troubles. But the one great factor which is constantly gouging the exchequer is the fuel bill, and it is the writer's belief that, were it possible to estimate or verify the statement, the expense incurred by excessive flange friction would be such that the above-mentioned items of cost would pale into insignificance.

At the present, great study is being given the locomotive superheater, and costly experiments are being made of the various types of superheaters on the big modern power.

Master mechanics are appealing to the locomotive engineer and fireman to study and use all means to reduce the fuel cost, exhortations are made to keep the engine from popping, because each pop means so much fuel, that watchfulness be kept on light spots in firebox, and all the tricks known to the successful fireman be exercised, still one of the greatest fuel consumers, flange friction, has been neglected.

The number of oil lubricating devices already on the market are limited and must necessarily remain so, as the methods by which oil can be successfully transmitted to rail do not allow of a great variation.

The point of delivery of oil to wheel must be constantly at the same place, which is the neck of flange, favoring a part of the tread of wheel as much as possible. The centrifugal motion of wheel will carry the lubricant to the periphery. Any device which places the oil high on flange or unduly on the tread of wheel should be avoided or an unnecessary waste of oil will result. The oil should be as cold as possible, the stickiness should not be disturbed by any atomizing agency in order that it may be successfully transferred to rail.

To reach success in flange lubrication, all dilatoriness must be dispensed with and every one concerned in the operation of trains should take the interest that his department is immediately concerned in.

The engineer should see that, as a safety device, he is most seriously affected; the master mechanic that his wheel trouble will be greatly reduced, and the M. W. department will be interested in the track with the constant regauging and renewal of rails.

And do not expect that a division of 150 miles can be lubricated with one pint of oil, and that charged as part of the engineer's oil performance. Give flange lubrication a proper trial by equipping not one but many engines, and the results will become apparent.

Doubtless there are other devices already on the market looking towards a perfect system of lubrication, but so far I have not seen any complete reports in regard to their operation, and, would be pleased to hear from any expert on the subject. RAILROADER.

Sacramento, Cal.

Piston Groaning.

Editor:

With reference to the letter in the August issue of RAILWAY AND LOCOMOTIVE ENGINEERING re piston groaning, I am of the opinion this can't proceed from the rings, and more especially when these become so badly worn that they fail to fit the cylinder all round. Your correspondent makes a mistake in assuming that when the engine takes steam the friction of the rings is equalized all round. When a ring has become worn to such an extent that it does not bear on the cylinder walls all round a "blow" takes place when the engine takes steam, and the effect of the steam blowing passed between the cylinder wall and the ring will tend to make the space greater, if anything.

Personally, I can hardly advance any theory why this groaning should take place only when the engine is drifting, except I might say imperfect lubrication under conditions as they exist while drifting. When the cylinders are working steam the oil will be deposited in a finely divided state all over the cylinder walls, but while drifting it is possible that a big percentage of the oil is deposited in the steam chest and never carried into the cylinder at all.

When groaning occurs I think it proceeds from the bottom side of the piston. The appearance of pistons when drawn indicates this, it will be found that the bottom side shows evidence of wear while the tool marks can be seen on the top. I don't think there is any reason why the weight of the piston on the bottom side of the cylinder should change in any way, steaming or drifting. We know while steaming the thrust of the crosshead is on the top guide bar, and while drifting it is on the bottom, that is, with the engine running ahead, but this does not apply to the piston. Perhaps while steaming there is more of a floating effect on the piston due to high velocity and pressure.

With regard to wear on rings, this is usually greatest on the side of the ring directly opposite where it is split, the reason being evident to anyone who will study the strains set up in the ring after it is cut and forced into the cylinder. Rings certainly ought to be changed as soon as they begin to "blow." This would be justified from a point of economy alone. The coal saved in one trip would cover the expense of changing rings.

Brandon, Man., Canada. R. BELL.

Apprentices on the Canadian Pacific at Winnipeg, Canada

By E. E. BAILEY, Supervisor of Apprentices
WESTERN LINES

Considerable attention is paid to careful and systematic education, both practical and theoretical, in the various trades required for the production of the shops at Winnipeg. A well-organized apprentice instruction department, in charge of a supervisor of apprentices under the direction of the superintendent of shops, controls the hundred apprentices employed at Weston, both in their shop training and in their instruction classes. Those learning the machinist trade, about two-thirds of the total number, have also a shop instructor, who is employed to devote his time to showing the boys how to handle their various jobs and who is responsible for passing them efficiently through the many branches of their trade in due order, scheduled periods for each being allotted. The remainder, including boilermakers, blacksmiths, moulders, pipefitters, tinsmiths, carpenters and patternmakers are under direct control of their respective foremen. A careful record of their progress, behavior and aptitude is returned to the supervisor, particular attention being paid to inculcating the habit of good timekeeping; twice late per month, or a total of twelve per annum, only being allowed, together with a total loss of time each year of a hundred hours, this being allowance for vacation. Any time over this has to be made up before the boy can receive his increase of pay, which rises automatically from 13 cents the first year to 17 cents the second, 20 cents the third, 23 cents the fourth and 26 cents the fifth, after which, on receipt of a satisfactory certificate of apprenticeship, they step at once to the schedule rates as tradesmen.

The technical or theoretical training, rightly considered as of great importance, is developed by means of classes conducted by the supervisor, fifteen boys being the average per class. In arithmetic all are taken through fractions, decimals, proportion, averages and roots and powers, and concluding with mensuration. In drawing they are instructed first in freehand, to be applied later in their training to the making of shop sketches. Then geometry, projections, intersections and developments of surfaces, and finally to the making and reading of shop or mechanical drawings, each trade being given, as far as is possible, subjects bearing on their own class of work.

Beyond this any apprentice who elects to pay a small sum per month may continue his studies in more advanced subjects, such as algebra, logarithms, trigonometry, advanced mechanical drawing, steam and kindred subjects, the companys' object being as much to enable the boys to realize the advantages of extending their technical knowledge as it is to give all a good training in the rudiments.

During their first year as apprentices, when they must be sixteen years of age or over, they receive two hours instruction per week; from then for the following two years, four hours per week is given, divided into two sessions of two hours each. At the end of the third year their theoretical training ceases, unless, as stated above, they wish to advance further, when they may continue to attend special classes until they have completed the branch of study chosen, or until they have completed their apprenticeship.

"THE MIDWAY." C. P. R. SHOPS. WINNIPEG.

A monthly record of school and shop progress is sent to each boy's parent or guardian, and copies are kept charted up in the Instruction Room for friendly rivalry and emulation. Each December an examination on the general progress of the classes is held, scholarships being presented to the five boys with the highest marks. All apprentices are also eligible to compete for the two scholarships offered by the company covering four years' free tuition in the Faculty of Applied Science of McGill University.

It will thus be seen that generous encouragement is given to every boy entering the Winnipeg shops as an apprentice, and that no effort is spared to turn out in the finished article a thoroughly well-trained and useful member of a trade, and it must be said that the boys themselves appreciate the efforts of the company to this end, and evince a willingness to learn, and an interest in their work, to go far to justify the trouble and money expended upon their training, and finally result to their own particular advantage in the coming years.

Japanese Railways

By H. W. DENNIE
Spokane, Wash.

References to the "diminutive empire" of Japan, and to "the little brown people" are so common among writers not thoroughly cognizant of certain facts and distances in the land of Nippon, that most Americans are rather surprised when they learn that Japan has over 5,000 miles of railways in operation, and that the total length of the trunk line of the country, with its extensions east and west, is 1,966 miles, or approximately the distance between San Francisco and Missouri river points.

The system includes a network of lines built on parts of the four main islands of Japan; Hondo, Hokkaido, Shikoku and Kyusho, and has for its eastern and western terminals, respectively, the cities of Kushiro, on the island of Hokkaido, and Kagoshima, located in the southwest corner of the island of Kyusho. Tokyo, Japan's capital, with its population of over 2,000,000, and Yokohama, the principal seaport, distant 18 miles from Tokyo, and situated on Tokyo bay, are almost in the middle of the railway system, the distance from the capital to Kagoshima on the west being 951.6 miles, and to Kushiro, eastward, 1,014.4 miles.

As is the case with quite a number of other concerns in Japan, the government owns the railways, which means that Japanese are employed exclusively, for year by year the policy of the Japanese has been to supplant foreigners who were necessarily hired at first not only with respect to railroads, but in other industries, and now the percentage of foreigners working for the government is very small in connection with anything controlled by the empire. For that matter, the same thing applies to commercial lines as well, and the foreign population of Japan is constantly decreasing instead of the reverse.

The first road was opened between Tokyo and Yokohama in 1872, and since that date improvements have been steadily carried out until, while the general comfort is still several degrees removed from that of the standard American roads, what might be covered by the French "tout ensemble" will compare favorably with a good many European systems and more or less with those of our own.

The writer spent the greater part of March and April in Japan this year, and judging from observation, the Japs appear to have gotten their ideas partly from European and partly from American sources. The roadbeds, as a rule, are better than those ordinarily found

in the United States, particularly the West, being better ballasted, and consequently freer from dust.

Another item to the advantage of the Japanese system is the cheapness. The government roads have three classes of fares, the ratio of which runs like this, 2½, 1½ and 1 cent. The ordinary rate for third class is—translated into gold values—.82½ for the first 50 miles. .65 for the second 50 miles, .50 for the second 100 miles, .40 for the third 100 miles, and 35 cents per hundred miles for any distance over 300 miles.

From Tokyo to Kagoshima, 951.6 miles, the first class fare is $10.06, second class, $6.03, and third class, $3.95, or a little over a cent a mile first class, and a trifle over a third of a cent per mile third class.

Of course, the European saying, "only fools and Americans travel first class," holds good as well in Japan as in Europe, and while anyone traveling third class must expect to put up with many discomforts, wedged in the little narrow cars with a horde of Japanese, the second class is not at all bad, and is resorted to by many foreigners who have a care for the elusive penny.

The vast majority of the cars of all classes are modeled on the extremely plain and, to American eyes, unattractive style of European rolling stock, except that they do not have side doors, as are frequently found in Europe. In the cases of the sleepers and diners on the through express trains, the coaches take on much more of the American aspect, though they are as yet several degrees removed from our splendid types.

The engines are rather a mixed lot also. Those used on the local line between Tokyo and Yokohama, the scene of the greatest traffic in the empire, are mostly German, and built, needless to say, without pilots and as devoid of what constitutes the beauty of an American locomotive as such machines generally are. On the through express lines American engines are used, built by the Baldwin and American Locomotive companies, but they are revolutionized to conform to the semi-European ideas until they are hardly recognizable to an American engineer. Also minus pilots, the throttle valve and reverse lever are installed on the left side of the cab, for in Japan, as in every country in the world except the United States, even including our own Philippines, the rule of passing to the left is carried out not only with railroads, but also with street cars, and in driving. The cabs of the express engines are not so comfortable as ours, while those of the European makes would hardly do for American engineers and firemen, so scanty is the room afforded. And, by contrast to the usual "uniform" of overalls and jumper worn by our enginemen, every Jap engineer and fireman, even on the local lines, must wear a complete uniform of dark blue cloth and a standing collar. How they manage to keep the latter clean for more than an hour at a time is a mystery, though the collar of their coats, which is cut in navy fashion, has something to do with that.

Up to date there are no "Limiteds" or "20th Century Trains" or anything of that sort in the matter of speed. The fastest time made in the empire is on the Tokyo-Yokohama local line, distance 18 miles, which is covered several times daily in 28 minutes, no stops being made. This gives a speed of about 38½ miles per hour. The ordinary local trains, however, which leave at frequent intervals, make about eight stops, and take 52 minutes for the trip.

One example of express time will answer. The distance from Tokyo to Kobe, 375.2 miles, covered by the fastest express of the system, a day train, takes 12 hours and 50 minutes, an average of not quite 29 miles hourly. No third class cars are carried on this train. The night express, however, which consists of third class cars only, takes about 15½ hours for the same trip, or a fraction over 24 miles per hour. So it will be seen that no speed records are broken in Nippon yet.

Mr. Asquith on the Nationalization of Railways.

Replying to a trade union deputation in London recently, that were favoring the nationalization of the British railways, Mr. Asquith said: "The real point that we have got to consider as practical men is what changes, if any, and in what direction, are necessary to bring our railway services in better conformity with the general needs of trade and of the community. The paid-up capital for 1911, the latest year for which the returns are to hand, was £1,324,000,000. The gross receipts were 127¼ millions, and the expenditure 78½ millions, and the net receipts were, therefore, little more than 48½ millions. That brings out a net return upon the capital of 3.66 per cent. If you take the years from 1902 until 1907 you will find, I think, roughly that the average percentage was about 3.44. The percentage return of 3.66 is the highest figure obtained certainly during the last ten years, and it is not, of course, a very high return for a commercial undertaking.

"Even when you have deducted all the 'watering' the return does not work out at more than 4.3 per cent. That is substantial, but even so it is not an extravagant return for a commercial venture which is attended with a great deal of risk, and in a great many cases the shareholders, the ordinary shareholders, have been kept for a long time without any return for their capital at all. The real practical question, apart from all the obvious difficulties attending a gigantic undertaking of this kind, is whether we should be better off after the operation was concluded. That depends on the number of years' purchase you are ready to give. The notion that you can reduce fares and rates and shorten hours of labor and raise the wages of persons employed without paying for the capital value of the undertaking, by a very small number of years' purchase, is to me an illusory notion.

"I should not do real justice to my own convictions or be acting fairly if I did not say quite frankly that at this moment I do not think the burden of proof—which is placed on those who are in favor of nationalization of railways—has been satisfied. I do not think it has, but it is a very large and complex matter, and in all its aspects worthy of full investigation, and it ought not to be on one side only, but ought to embrace opportunities for hearing all the interests concerned."

Past Practice of Rate Cutting.

There was a time not so long ago when certain railroad officials would take business at less than cost. That was competition gone raving mad. Competition must have its limitations. The tendency to indulge in ruinous competition has been the most powerful interest in the promotion of trusts that could act the part of monopolies.

Dishonest competition is in the end ruinous to all concerned. It causes waste and losses which someone must provide for, and those who indulge most freely in the vice generally pay the cost. While this principle is just as true of any other business, there seems to be a wide misunderstanding on the subject regarding railroad business. That the public suffers whenever a railway undertakes to apply the policy of performing service at unprofitable terms is necessarily true, but the effect is not realized at once. Much of the sentiment against railways has arisen from the practice of secretly cutting rates favoring certain shippers at the expense of the community.

Steel and Iron.

The elastic, tensile and compressive strength of steel is nearly twice that of wrought iron which commends it for all parts subject to severe stresses. The strength and rigidity of steel being greater than iron and having greater hardness and uniformity it will wear longer than iron and is therefore the best material, and the marked improvement in its manufacture is one of the triumphs of the age.

Mikado Type Locomotives for the Rock Island Railway

Forty locomotives of the Mikado type have recently been built for the Chicago, Rock Island & Pacific Railway by the Baldwin Locomotive Works. These are the heaviest engines of that type, weighing in working order 318,850 pounds. Their tractive force amounts to 57,100 pounds.

The boilers of the new locomotives are of the straight top type, and measure 86 ins. in diameter in front. The firebox throat is 25¼ ins. deep, measured from the under side of the barrel; and ample room is thus provided for the installation of a brick arch, which is supported on four tubes. The superheater flues are 5½ ins. in diameter, and are arranged in four horizontal rows, with nine flues in each row. The small boiler tubes are spaced with ⅞ in. bridges.

The firebox volume is unusually large, and the depth of the box, at the front end, is 90 ins. Flexible bolts to the number of 550 are used in the water legs. These stay the entire throat and are placed in the two outside rows in the back head. In the sides they are applied in the two front and two back vertical rows, and in the two upper horizontal rows, the remainder being grouped in the upper corners.

The main frames are of vanadium cast steel. They have a width of 6 ins. and a depth of 7 ins. over the pedestals. The front rails are single and are cast in one piece with the main frames. Each rail is 11 ins. deep and 6 ins. wide, and is strengthened on the bottom by a rib which is 2 ins. wide by 4 ins. deep. As is usual in a locomotive of this size, cast steel is used for all the important frame braces. It is also used for the driving equalizer fulcrums. These act as filling pieces between the upper and the lower frame rails, and are designed to carry the brake hanger pins. Both the guide yoke and guide bearers are of cast steel.

The cylinders are bushed, and the steam distribution is controlled by 16-in. piston valves which are driven by Baker gear. The valves are set with a travel of 6 ins. and a lead of ¼ in. The steam lap is 1 1/16 ins., and the exhaust clearance 1/16 in.

The Ragonnet power reverse gear, operated by compressed air, is applied to these locomotives. This gear is proving most successful, not only on Mallet locomotives, but also on heavy engines of other types in both road and switching service. With this gear the locomotive can be handled with a minimum amount of effort; and the absence of a long reverse lever in the cab is a great advantage, especially on heavy power. Furthermore, with a power gear the cut-off can easily be changed while running, and the locomotive can thus be worked to the best advantage.

The trucks are of the arch bar type, with cast steel side frames and bolsters. This is an advanced design of heavy freight locomotive, which however, possesses no radically new or untried features. With high boiler power and comparatively large wheels, these engines are specially suited to heavy freight service where speed is an element of consideration. There is every assurance that their performance will be most satisfactory.

The following are the principal dimensions of this type of locomotive:

Gauge, 4 ft. 8½ ins.

Cylinders, 28 ins. x 30 ins.

Valves, balanced piston.

Boiler.—Type, straight; material, steel; thickness of sheets, ⅞ in.; working pressure, 180 lbs.; fuel, soft coal; staying, radial.

Firebox.—Material, steel; length, 108 ins.; width, 84 ins.; depth, front, 90 ins.; depth, back, 77 ins.; thickness of sheets, sides, ⅜ in.; thickness of sheets, back, ⅜ in.; thickness of sheets, crown, ⅜ in.; thickness of sheets, tube, ⅝ in.

Water space.—Front, 6 ins.; sides, 6 ins.; back, 6 ins.

Tubes.—Diameter, 5½ ins. and 2¼ ins.; material, 5½-in. steel and 2¼-in. iron; thickness, 5½ ins., No. 9 W. G. and 2¼ ins. No. 10 W. G.; number, 5½ ins., 36; 2¼ ins., 238; length, 21 ft.

Heating surface.—Firebox, 232 sq. ft.; tubes, 4,004 sq. ft.; firebrick tubes, 28 sq. ft.; total, 4,264 sq. ft.; grate area, 63 sq. ft.

2-8-2 TYPE OF LOCOMOTIVE FOR THE CHICAGO, ROCK ISLAND & PACIFIC RAILWAY.

T. Rumney, Asst. V.-Pres., in charge of Mechanical Department. Baldwin Locomotive Works, Builders.

Driving wheels.—Diameter, outside, 63 ins.; diameter, center, 56 ins.; journals, main, 11½ ins. x 13 ins.; journals, others, 11 ins. x 13 ins.

Engine truck wheels.—Diameter, front, 33 ins.; journals, 6½ ins. x 12 ins.; diameter, back, 42 ins.; journals, 9 ins. x 14 ins.

Wheel base.—Driving, 17 ft.; rigid, 17 ft.; total engine, 35 ft. 2 ins.; total engine and tender, 67 ft. 2½ ins.

Weight.—On driving wheels, 243,200 lbs.; on truck, front, 25,500 lbs.; on truck, back, 50,150 lbs.; total engine, 318,850 lbs.; total engine and tender about 480,000 lbs.

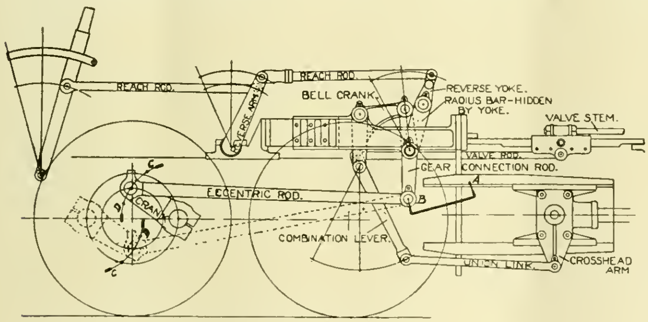
Tender.—Wheels, number, 8; wheels diameter, 33 ins.; journals, 6 ins. x 11 ins.; tank capacity, 9,000 gals.; fuel capacity, 16 tons; service, freight.

Engine equipped with Schmidt superheater. Superheating surface, 905 sq. ft.

General Foremen's Department

The Baker Locomotive Valve Gear.

The interest which has always attached to the subject of valve gearing seems perennial, and recent years bringing as they have an increase in the size of locomotives, naturally and properly brought a new interest to the subject of valve gearing. The limit of space inside the engine frames doubtless called the Walschaerts gearing into American locomotive service. In the important features of accessibility it is certainly an improvement on the so-called Stephenson gearing. But American enterprise did not stop at the mere adoption of the clever Belgian device. Hence the appearance some years ago of the Baker-Pilliod valve gear, which after passing through the experimental stage, and undergoing several organic changes, has now, with increased merit in point of efficiency, taken a settled form and is now known as the Baker valve gear.



THE BAKER VALVE GEAR.

Over 400 American locomotives are now equipped with this valve gearing and nearly 50 railroads have installed the gearing as part of their equipment and the reports, from all who have reported, are of the most gratifying kind.

A brief description of the gearing will be of interest, as the variation from any other form of valve gear is particularly marked. Like the Walschaerts gearing the movement is derived from the crosshead and a single eccentric crank. The crosshead connection has the effect of moving the valve the amount of the lap and lead, and the eccentric crank gives the required movement for the amount of valve travel. These peculiarities are similar to the movement in the Walschaerts valve gear, but whereas the Walschaerts gear is equipped with an oscillating link through which the movement passes to the radius bar and valve rod, the designers of the Baker gearing have dispensed with the use of the link and by an ingenious bell crank connection the motion is transferred to the radius bar and valve rod. As is well known among engineers, the avoidance of the variations due to the slip of the link and link block is a decided gain in value wear mechanism, especially when the parts gather lost motion incidental to service.

In this regard the Baker valve gear lends itself readily to massiveness of construction. The bearings and bushings may readily be made of ample dimensions, and a degree of security and an assurance of a continuity of fixity in position may be attained hitherto unknown in valve gear construction and adjustment.

In addition to this important advantage there are other peculiarities in the movement which have been cleverly used to advantage by the inventors. It will be readily noted that when the piston is at the end of the stroke and the valve opening begins the eccentric rod is then passing through space at its highest point of speed. At the same time the crosshead connection has the effect of further accelerating the motion of the valve which opens the port rapidly, and as the crosshead advances toward the middle of the stroke, increasing in its velocity, the eccentric rod diminishes in speed and eventually lingers at the point where the steam port is completely open, and as the point of cut-off approaches the valve is closed with an increasing degree of rapidity. This eccentricity of movement is more or less exemplified in almost all kinds of valve gearing where steam is used, but in none is it more pronounced than in the case of the Baker gearing, with the exception, perhaps, of the Corliss valve gear, which with its delicate mechanism is not adapted for use on locomotive service.

The readiness with which the Baker gearing may be applied to any locomotive is of advantage in its introduction on locomotives now in use. Engines equipped with the Stephenson valve gear where the parts are much worn may have the Baker gear applied at less cost than is necessary for a reconstruction of the older gearing. While many new locomotives are being equipped with the new gear, of which the Mikado type of locomotive, furnished by the Baldwin Locomotive Works, and which are described in another part of the current issue of our magazine, are an illustration, many locomotives that have seen much service are being refitted with the Baker valve gearing, and the advantage gained is, as far as we have been able to learn, very warmly appreciated.

Roundhouse Efficiency.

By T. F. Griffin, General Foreman, C. C. C. and St. L. Ry., Indianapolis, Ind.

Regarding roundhouse efficiency will state that the first thing to do is to get our engines in the roundhouse as soon as possible after arriving, so we can get to work on them and get them ready for service. To take note of engine crews coming in with heavy bad fires that take twice as long to get fire knocked out as other engines of the same class and service, to make report of this to road foreman. To get after crews that they are delaying engine and wasting coal, as unburnt coal goes in cinder car.

To provide a clean, comfortable washroom with hot and cold water for engine crew, close to pit so crew can go there and wash, and not wash on engine and hold the engine until they get washed and dressed, and tell all about their trip, as this will delay engine from 15 to 30 minutes. To have a live man for hostler and fire knocker, a good ash pit well drained, a good coal chute to hold 200 to 400 tons, take coal and sand on both sides, use one side for incoming and other side for out-going track. Have an active roundhouse foreman and boiler foreman, so they know as soon as engine strikes turntable from ash pit, if engine is due for a washout or not, so they will start cooling them down the minute engine arrives at roundhouse. Have a good inspector of engine, tank and air. Inspector to read engineer's work report on work book, then make a thorough inspection, make a report of all defects that he finds in writing and give to roundhouse foreman, to start the different class of men to work on engines,

and to give them to understand that they are held responsible for the work they perform, or in other words "every tub ou its own bottom." After work is done, inspector goes over the engine and gives it his approval. At 7 A. M. roundhouse foreman and boiler foreman go over all freight engines that are in the house. That gives them one hour from 7 to 8 to examine all work reports and firebox, and give approximate time engine will be ready for service. I give this to trainmaster and yardmaster, so it will give them an idea time they can have power, and as engines are different sizes, will enable them to know what tonnage to put in train, as engines are given in rotation as they go out. Another thing: it stops them from calling up every 15 minutes wanting to know about engines.

Now, your safety appliance must be given close attention and kept within requirements of the law. I hold tank inspector entirely responsible for this inspection, and have him keep a record of condition of each and every engine, height of drawbars on both ends of engine, and all other appliances.

Then the boiler inspection hydrostatic and washout—we have one man who inspects all stay bolts and all interior and static test in company with machinist, exterior inspection and gives all hydro- who removes dome cap and stand pipe and tests steam gauge and sets safety valves at given pressure. We keep a book record of all this work, as well as cards filled out and placed in cab, which are sworn to by notary, who is one of the men working in shop, so there is no time lost having them sworn to. We hold our boiler foreman wholly responsible to watch this and see that they are made out properly and not allowed to overrun their time of expiration.

Now the most serious thing that is now involved is the smoke question. We have several law suits now pending, and have done everything in our power to eliminate smoke. We have placed tubes through side of door sheets with steam jets on outside to act as a mixer and draw air over fire. We also applied a cast iron ring in front end around top of exhaust pipe 14 inches diameter with 3-16 inch holes spaced so we can fill stack with steam at base of stack, making a fierce vacuum in front end drawing air through grates. I find this a better method than tubes and jets on firebox, as the air is heated by the time it gets through coal and don't reduce temperature in a firebox and kill combustion. If any of your readers know of a better method I would like to hear from them, as this matter is getting serious in this section of the country.

Roundhouse and tools.—Keep your roundhouse clean and free as possible from smoke by keeping engines under jacks. Keep the house warm and comfortable in cold weather by having doors closed immediately when the engine leaves the house, and in extreme cold by rolling gunny sacking around in a pillow form, so you can place at opening under door and over rails. This will add much to keeping house warm, and the more comfortable you keep your men the more work you will get out of them, and better class of men you can get and hold. Now, for the tools: that is one of the most important things in roundhouse. Boilermaker should have a rack exclusive for boilermaker tools, and different kinds to do their work and allow nothing else in this rack.

The boiler washer to keep all his tools and wrenches in a portable box that he can wheel around to the engine he works on. The air man to have a separate room in one end of roundhouse with all necessary tools to handle different size pumps and brake equipment, with test plant to test all his work and know it is right before applying, and have gauges with hose attached to test air and steam on every engine before leaving roundhouse.

Also have a good tool room under a reliable man to keep all tools in good shape and see that they are not lost, to keep a record of work done on different class of engines and have tools best adapted for work, watch parts of engines that fail mostly and study how this can be overcome, whether not of sufficient strength or faulty construction, and make your recommendations. If overcome by making out of stronger or tougher metal, or changing construction of parts and save many delays to train, and save labor.

If you would go out through your scrap pile and notice the different parts you will find there and several of the same class, you will surprise yourself how many ways you could think of to improve this broken material, you find so many that is not all caused by rough handling, and if some of the men come to you with an idea cheerfully listen to it whether it sounds good or not, and thank him for it. Make an inspection in a manner that you will know the exact condition of all engines on your division, such as sharp flanges and other wheel defects, so you can arrange to apply and put engine in shape without holding engine off its run or working your men overtime to do work, to have driving box brasses, and boxes fit and other material, pistons, cylinder heads, glands, packing, bull rings and all such material ready to apply the minute you hold your engine, and by knowing what is broken before engine is held you can do it.

Keep right in touch with your storekeeper and see that you have material that is required always on hand, and check up from day to day that material is not getting obsolete, if so get rid of it or send it to some other point on the road where they use it. Try and keep your stock down to 30 days' supply.

Don't see anything go to waste that costs money. If you have any exhaust steam, bottle it at once, use it to heat your house in winter and water at all times, your old dirty waste to be used, boil in warm oil and use on freight cars, heat oil with steam coil.

One of the best investments we ever made was to take charge of all tools on all our engines and headlights, in so doing we placed an old box car between ingoing and outgoing tracks we fit car with one end door and two side windows to raise and lower with counter covered with tin to receive tools and oil cans, and discharge them on opposite side, car is equipped with electric and steam heat, shelves to hold tool boxes, oil cans, shovels and all lights and headlight with number of engine on, we have one man in charge day and one at night. We receive all tools and supplies off all engines, each engine has an iron tool box with all necessary, small tools checked up each trip by man in tool car, and if any tools or lamps are missing or not in good condition, they are placed in condition and missing tools reported to foreman, who takes it up with engineer to learn what became of the tools.

The man in tool car removes and replaces all tools. Fill all oil cans for the regular trip supply, clean all headlight reflectors and fill with oil. He has a vice and bench in car and collects all the old and broken parts, and fits up good wrenches and puts them in stock for engines and not charged out, he puts handles in coal picks and coal shovels, and keeps all tools in good order. You would be surprised how much trouble and delay this plan has overcome—engineers about leaving time hunting foreman that some one stole his (monkey) wrench.

Next thing of importance is a good clerk who keeps a good record of all material received and all charged out. Keep a good record of all letters received, to have a data, collected on lots of matter before he receives letter and make immediate answer, when necessary to send letters to different foremen for information to keep a check on each letter, and if not returned in a reasonable time to demand them at once, as the man who is now handy with the pen, is what satisfies railroads.

Roundhouse to have a suitable train board to mark engine crews on trains and time they are to leave, also a board for boilermaker with engine number he works on and to check off time O. K. with his mark, to be checked off by boiler foreman on book, and if any failure of flues you can check who did work, and the bad work will come back on him, also a board for boiler washers, boiler foreman to mark

up engines due for washout and check off when O. K., so that roundhouse foreman can examine boards and see work is done without running to different men. Also a board to mark extra engineers and extra firemen, absent engineers and absent firemen, engineers and firemen O. K. for their respective engines, the number of the engine the extra engineer is on, the number of the engine the extra fireman is on, by this I have a block system and know where engine crews are at all time. There are only three places they can be—working, absent, or on the extra board.

Improved Piston Valve Packing Rings.

The American Balanced Valve Company, Jersey Shore, Pa., have recently introduced a new and important improvement in piston valve packing rings that is meeting with warm approval.

The importance of superheated steam on the locomotive whereby the capacity of the locomotive is increased is so well established as to insure a very general use of superheated steam, the importance, therefore, of every adjunct connected with the use of steam at a high degree of heat is of the next importance to the superheating of the steam itself; of these adjuncts the main valves are no doubt of the greatest importance. It is, therefore, interesting to know that The American Balance Valve Co., who have made main valves their specialty since 1890, have developed valves both of slide and piston type which are highly efficient under the highest degree of heat yet obtained by locomotive superheaters.

The latest development of the semi-plug piston valve provides a predetermined limit of wear to the rings, after which the rings are automatically converted into absolute plugs. The principle of the semi-plug valve is to allow the rings to expand by their own tension and to be set out by jets of steam until the rings fit the valve cage, then by the steam pressure operating the locking rings the packing rings are held from bearing against the cage, making an automatically adjusted plug, the ideal valve which cannot wear the cage.

This has worked so well in saturated steam that rings have been allowed to run without attention until mileages as high as 140,000 in freight and 120,000 in passenger have been made without changing packing, under such remarkable service it is very natural that the valve would receive very little attention and in this there was danger of letting them remain in service until they were so completely worn out as to be in danger of breakage and in superheat this is magnified because of greater difficulty in lubrication. It has been found advisable, therefore, to limit the wear of rings to a predetermined amount, after which the rings become absolute plugs and further expansion being impossible, warning will be given that rings require changing and new wearing rings are taken from stock and applied without machine or hand work on rings or spools, therefore the improvement in this valve was designed to remedy these points by doing away with the necessity of frequent inspection to determine when packing is worn out, by automatically giving notice and louder and louder insisting on attention while at the same time automatically preventing the wearing of rings being applied to the danger point by completely stopping the expansion of the rings at the predetermined point allowed for wear. This automatic watching and control of the packing is accomplished in a very simple manner and is of greater importance than might at first appear.

The ideal conditions have been reached in the semi-plug piston valve which automatically cares for expansion and contraction and still gives the frictionless service of a plug and in further supplying to the valve self protection.

It is also very interesting to know that a silde valve can be operated under 650 degs. temperature of steam; the Jack Wilson Valve has been operating since December, 1909, under these conditions and is being applied in other cases which will further demonstrate its ability to meet the conditions of superheat, since there are a great many slide valve engines still in use that could be equipped with superheat if the satisfactory valves were obtainable, and thereby avoid the expense of changing the cylinders simply for the purpose of using superheat. This slide valve becomes more interesting, and no doubt there are many who will investigate its service with the view of applying it to slide valve engines, to which it would be a great advantage to apply superheaters if it could be done by merely changing the valves.

Pulling Out Drawheads.

Pulling out coupler drawheads is a constant source of delay to trains and frequently causes serious accidents. One of the most disastrous train accidents on record this year was indirectly due to the pulling out of a drawbar on a freight train which kept a passenger train obstructed on the main line until it was dashed into by another train.

Some engineers have an evil record for pulling out drawbars while others very rarely cause that source of delay. To avoid pulling out drawbars great care and keen judgment are necessary, combined with good sense and not a little skill. Any influence which will impress upon engineers the necessity for doing all in their power to avoid pulling out drawbars, is likely to exercise a good effect, and we know of no better way to restrain the destructive tendencies of men who start trains violently, than that of making their record as drawhead breakers public in comparison with the records of more careful engineers.

The best precautionary measure adopted to restrain the evil of drawhead pulling out that we know of, has been devised by Mr. E. A. Miller, superintendent of motive power of the New York, Chicago & St. Louis, and is regularly practiced on that road with the most gratifying results. A monthly record sheet is kept showing the number of couplers pulled out with the name of the engineer in whose hands the accident has happened. This is posted in conspicuous places and copies are sent to all the master mechanics, superintendents, train masters, road foremen of engines and general officers. The reports indicate that most of the accidents are caused by the younger engineers and that the older men are practically free from the trouble. As time goes on, when skill and care come into full operation, it is expected that pulling out drawheads will be an accident of rare occurrence.

One of Robert Hunt & Co.'s Tests.

Nearly all railroad men who have employed Robert Hunt & Co. to make tests of material, have been impressed with the painstaking methods followed in doing the work, rendering the report of tests absolutely reliable. That company has been engaged lately in making tests of material subjected to the Lohmannized process and the following conclusions were reported by Robert Hunt & Co.:

In our opinion based on our examination and microphotographs submitted, the material treated by the Lohmann process shows an intimate contact and integral union between the base metal and the coating.

In our opinion material treated by the Lohmann process, in accordance with their specifications, should withstand rust and corrosion to a very marked degree.

This year's grain crops in the United States will be far in excess of last year's yield, says the Department of Agriculture. It will be better than the average crop for the past ten years, and in the case of a number of products will make a new record, if present estimates are not overthrown. The wheat crop, estimated at 680,000,000 bushels, will rank fifth in size during the past twenty years.

Among railway men, a thoughtful and active mind is the first necessity for safety; but in the hazardous occupation of train operating it seems that attention to safety has been secondary and occasional instead of continuous and of prime importance. The man who thinks it is heroic to take chances is the pest of railway life and the murderer of innocent travelers.

New Railway Bridge at Lachine, Quebec, Canada

One of the many gigantic works which the Canadian Pacific Railway is carrying out at the present moment is that connected with the double tracking of the bridge which crosses the St. Lawrence river at Lachine, Que. The Canadian Pacific Railway in carrying out this great work is continuing its policy of double tracking throughout its entire system, and it is anticipated that before many years have passed away the country will boast of a double track from St. John to Vancouver. Owing to the great difficulty in securing the requisite number of men in various parts of the country the company is somewhat handicapped in pushing forward the huge work of double tracking. The contracts were let to the Foundation Company and Dominion Bridge Company, whose works are practically on the spot to carry out the change. The cost of the improvement will absorb three millions of dollars.

It was on July 12, 1910, that the first operation was made on the enlargement of the old piers to carry the new girders before any of the new steel could be swung. This in itself was a huge job, and the Foundation Company undertook to complete the first eleven piers during the first season. However, this was not accomplished, but was completed by November 8, 1911, leaving only pier 13 on the up stream side

RIVETERS AT WORK ON THE NEW BRIDGE.

to be finished when the cantilever is taken out, but this will not be started probably until next year, as until the last two stages are completed, which is part of the work now under way, this cannot be done, owing to the cantelever tracks of the bridge being in use. The work in the vicinity of the while the bridge across the Lachine Lachine bridge is of a very extensive character, and not only includes the enlargement or double tracking of the structure across the St. Lawrence, but three other bridges are to be double-

CANTILEVER BRIDGE TO BE REMOVED.

tracked approaching the main bridge, canal will in the near future have to undergo the same fate. New spans have been inserted in the new bridge that crosses the Grand Trunk railway at Rockfield and the work is being rushed forward with all speed, and the filling up of the sidings for the double tracks approaching on either side is being continued. At the Highlands extensive works are also being carried out, but the principal improvement and the most costly is that relative to the St. Lawrence river bridge. The work on the superstructure of this great undertaking was commenced on March 15, 1911, when the placing of the two eighty-deck plates was first undertaken and ever since the work had been hurried forward with all speed. The bridge when completed will contain steel spans as follows: Six 80 ft. long, sixteen 120 ft., four 270 ft., two 122 ft., eight 240 ft., four 270 ft., and four 480 ft., making the total length of the bridge in spans 3,138 ft. The bridge was "cut down" so to speak from four 240's to eight 120's as far as pier seven.

The introduction of the smaller spans had no tendency to reduce the strength of the bridge, but, on the other hand, it greatly increased it, as the weight was being carried by more spans on shorter lengths. During the carrying out of the work only two crossovers were necessary to complete it to the eleventh pier from which point the huge through spans or channel spans which are 480 ft. long commence. The placing of the spans has reached such a point that no further crossovers will be required and the traffic will cross on the steel on the west side of the bridge until the east is totally completed, which it is expected will be by this fall, provided everything goes on smoothly.

The work has now commenced in connection with the placing of the two 408 ft. spans, which will complete fully the west side of the bridge. The huge spans are at present being erected at the yards of the Dominion Bridge Company, which are in close proximity to the bridge, connected by a spur line. As soon as this is finished the spans will be re-erected on the finished deck plate portion of the bridge on the Caughnawaga side of the stream, where space sufficient in length has been left for the purpose.

It is expected that the work which has to be done before the bridge is finally completed for double track service, will occupy at least another twelve months. The work of floating in the four huge spans will almost occupy as much time as the rest of the bridge has done. These through channel spans are not of the cantilever type, but the strength of the bridge will be below, and when the work is finished the bridge will constitute one of the finest pieces of engineering work on the continent. The two flanking spans on the south side are practically completed.

END OF PIERS OF THE NEW BRIDGE.

It is interesting to note that in the new bridge there are no less than 8,072,252 lbs. of steel. The eight-ft. lengths run 110,000 lbs., the 120's 226,000 lbs., the 240's 960,000 lbs., the 270's 1,324,138 lbs., and the 408's 2,600,000 lbs.

Questions Answered

SUPERHEATER LUBRICATION.

199. D. M., Villa Grove, Ill., writes: Why is it that the superheater constructors design the lubricating apparatus so that there is about four times the amount of oil fed to the valve chests that there is to the cylinders, when the cylinders have at least 95 per cent. more wearing surface? A.—The lubrication of the cylinders in all locomotives depends largely on the amount of oil admitted to the steam chest or valve chest, as the oil immediately passes from the valve chest into the cylinders. On locomotives equipped with superheaters a limited auxiliary supply is admitted into the cylinders as the tendency of the lubricant to carbonize is apt to develop when the cylinders are heated beyond the flash point of the lubricant. This may occur when the steam is shut off, and in such case the separate cylinder supply would continue to lubricate the cylinders independently of the supply from the steam chests.

INJECTOR TROUBLES.

200. F. B., Huntington, Ind., writes: Injector troubles seem to increase in this locality. Some blame the water from the Little Wabash river. Others blame the injectors themselves. What are the chief causes of failures of injectors? A.—The chief causes of failures in injectors are largely to be traced to defects in the suction pipes. Poor metal in the pipes and leaky joints form a combination that render it impossible to produce a perfect vacuum, without which an injector will nearly always give trouble. Some kinds of water are worse than others in precipitating matter on the nozzles and obstructing the current of steam and water through the injector. Leaky valves and checks also affect the injector, especially in starting, as all leaks tend to heat the suction pipe. If injectors are in perfect repair and all pipes and joints air tight, the injector should give no trouble.

ROUNDING CURVES.

201. M. De S., Wendling, Cal., writes: In running round a curve at any rate of speed, which particular wheels travel fastest? The subject has aroused considerable interest here. I claim that the outside wheels travel faster, as they have more space to cover in rounding a curve. A.—Locomotive or car wheels being securely attached in pairs to an axle, the one cannot travel faster than the other. In rounding a curve the outside wheel must necessarily travel further than the inside wheel. There are two ways in which this variation is made up. The first, or theoretical way, is by having the tread of the wheels turned slightly tapering with the lesser diameter at the outer rim of the wheel. In rounding a curve the flange of the wheel must necessarily be forced against the outer rail and consequently the larger diameter of the conical-shaped tread of the wheel will come in contact with the rail, while at the inner side of the curve the smaller diameter of the wheel will come in contact with the rail. As curves are variable and wheel treads wear and flatten it is impossible to maintain a uniformity of tread to suit every condition and hence it is safe to assume that, in general practice, the wheel on the inner rail of the curve slips more or less. This is the more practical view of the situation, and doubtless the slipping of the wheel traveling the shorter distance may be looked upon as accounting for the variation.

REVERSE LEVER JERKING.

202. W. S. G., Scranton, Pa., writes: Recently in several instances a sudden jerking of the reverse lever has occurred without any apparent reason. The locomotive was recently repaired and everything is in fine condition. Possibly you may have heard of such trouble, but it is new to me. —A. If the locomotive is equipped with piston valve, the trouble may be in the lack of proper lubrication, or the valve may be too snugly fitted and the admission of steam may have the effect of expanding the valve more than the casing. This would have the effect of tightening the valve in the casing and might cause the jerking referred to. If the trouble is a growing one, the cause must be looked for elsewhere. If the trouble is lessening it will likely vanish in a short time.

LEFT MAIN WEDGE.

203. A. G., Ennis, Tex., writes: Some engineers claim that it is necessary to give more attention to left main wedge, with a right lead engine, than is necessary for right main wedge. If so, why?—A. All wedges should receive equally careful attention. That there is a greater strain on the left side of a locomotive is generally admitted. This is owing to the relation of the crank pins which being set at 90 degs. apart have an unbalanced space between the thrusts of the pistons. By following the movement of the crank pins with the engine moving forward and the right crank, as is nearly always the case, leading, it will be readily seen that the regular location of the cranks and the consequent eccentricity of the thrusts superinduce a heavier degree of shock on the left side or main driving box of the engine. In running backwards this would be reversed, and the right side would sustain the heavier shocks. As the greater part of locomotive work is accomplished while the engine is running ahead, it would be reasonable to assume that the wedge on the left main pedestal would have a perceptibly greater tendency to loosen than the wedge on the right side, but all should receive careful and intelligent attention.

POSITION OF TRIPLE VALVE.

204. A. G. Ennis, Texas, writes: It is said that when making a service application with the Westinghouse K triple valves on long trains, that in all cases the quick service feature is automatically cut out after 25 lbs. brake cylinder pressure has been obtained. If so, what causes it to cut out? A.—The so-called "cutting out" of the quick service feature occurs at a time the brake pipe reduction is rapid enough to cause the triple valve piston and slide valve to be moved to full service or emergency position. The position of the slide valve is governed by this rate of reduction, and as a general proposition it is in no wise affected by the pressure in the brake cylinder. The quick service feature will not cease to be of effect until very nearly the point of equalization has been reached or until the quick service posts have been blanked by a movement to full service position, and in any ordinary service application of the brake the slide valve, in the majority of cases, stops a little short of quick service position, so that the quick service port is open a small amount. For this reason the quick service feature may not amount to a great deal after the first reduction, but the opening from the brake pipe to the brake cylinder will be greater or less according to the position of the slide valve after the first movement.

There is, of course, a possibility of the slide valve being moved from its first position by a sudden increase in the rate of leakage during a subsequent reduction, and the movement may be assisted by the somewhat slower rate of expansion of auxiliary reservoir pressure as the pressure reduces.

Jacket Metal Free from Corrosion.

We understand that the illustration, which we published of a locomotive belonging to the Erie Railroad covered with steel treated by the Lohmann process, has excited wide-spread attention. It is realized that a process that will free the jacket metal from corrosion, will effect material saving in the maintenance of locomotives.

Apply glycerine to a scald directly the accident happens, and cover it up with strips of rag soaked in glycerine. If the glycerine is not at hand, apply salad oil in the same way.

Railway & Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances.

Published Monthly by

ANGUS SINCLAIR CO.

114 Liberty Street, New York.

Telephone, 746 Rector.
Cable Address, "Locong," N. Y.
Glasgow, "Locoauto."

Business Department:

ANGUS SINCLAIR, D. E., Prest. and Treas.
JAMES KENNEDY, Vice-Prest.
HARRY A. KENNEY, Secy. and Gen. Mgr.

Editorial Department:

ANGUS SINCLAIR, D. E., Editor.
JAMES KENNEDY, Managing Editor.
ALLEN G. WOOD, Consulting Engineer.
GEO. W. KIEHM, Associate Editor.
A. J. MANSON, Associate Editor.

Boston Representative:

S. I. CARPENTER, 643 Old South Building, Boston, Mass.

London Representative:

THE LOCOMOTIVE PUBLISHING CO., Ltd., 3 Amen Corner, Paternoster Row, London, E.C.

Glasgow Representative:

A. F. SINCLAIR, 15 Manor Road, Bellahouston, Glasgow.

SUBSCRIPTION PRICE

$2.00 *per year,* $1.00 *for six months, postage paid in the United States, Canada and Mexico. For other parts of the world,* $2.50, *or ten shillings. Single copies, 20 cents. Remit by Express Money Order, Draft, Post Office Order or Registered Letter.*

Mailing address can be changed as often as necessary—always give old and new address, and if you subscribe in a club, state the name of the agent.

Please give prompt notice when your paper fails to reach you regularly.

Entered at the Post Office, New York, as Second-class Mail Matter.

Coming.

Beginning with our October issue, our Educational Department will have several articles by Mr. F. P. Roesch, master mechanic of the El Paso Southwestern on the Construction and Operating of Mallet Locomotives. These articles are of a decidedly educational character, by an excellent writer who is thoroughly master of his subject. There are few railway men who will fail to obtain valuable information from a careful study of these articles.

Later on we expect to publish articles on Air Brakes from our accomplished correspondents, Mr. S. J. Kidder, and Mr. J. P. Kelly. We expect to begin the work of next year with many other interesting and instructive articles.

Different Degrees of Inspection.

When an engineer or inspector fails in the course of inspection to find defects that afterwards make trouble, the person who displayed neglect is generally severely reproved. But neglect higher up that fails to detect defects that prove very expensive is readily excused. An Institution of Technology specification designed for locomotive fireboxes called for best open-hearth steel three-eighths thick, having a tensile strength of not less than 55,000 pounds per square inch, the steel to bend double cold, red hot and at flanging heat without cracking. No lamination was to exist in any of the specimens or the plates. From each plate to be used were to be cut four specimens, being at least 18 ins. long and planed on the edges to a width of 1 in. throughout its length and was not to be annealed.

Every specimen of the steel furnished under these specifications failed when subjected to the careful tests made of the Institute. The principal cause of failure was lamination of the sheet when bent cold. Some of the steel makers asserted that the requirements were too onerous and could not be complied with, although the same men are willing to supply railroad companies with steel under the same specifications. They evidently rely on the steel being accepted without being subjected to careful tests, and it seems that their faith in loose inspection is well founded. Railroad companies are required to pay for the best quality of steel. It is the blame of those in charge if they fail to receive what is paid for.

Increasing the Power of Locomotives.

The tendency of railroad companies towards locomotives of increased capacity is well illustrated by a remark made by Mr. A. H. Smith, vice-president of the New York Central lines, in giving testimony before the Arbitration Committee investigating the demands of locomotive engineers for increase of wages. Mr. Smith said:

"Since 1900 we have demolished about 1,200 small locomotives. A large portion of these were of the mogul and consolidation types. We pay to-day $4.75 per 100 miles for the few remaining engines of these classes that are in service in local freight and miscellaneous service."

This tendency has been going on steadily since about 1870. At that time the 4-4-0, or so-called American type of locomotive, was almost universally used for both passenger and freight service. Then a sentiment arose in favor of introducing engines that would pull very heavy trains with the view of reducing the cost per ton handled. The expense of moving freight was supposed to be greatly reduced, but there always was a tendency to overlook many individual expenses, such as wear of track, cost of increasing the strength of bridges and other structures, damage to cars, etc. We have always believed that had all these sources of extra expense been taken into consideration, the work done by the old eight-wheel engine would hold a higher place as a factor of motive power than it does to-day.

Careful Habits and the Reverse.

What is of greater importance than technical instruction to people connected with the moving of trains, is the cultivation of careful habits. The reckless character, the man who thinks not about his work, might suit the decaying occupation of stump digging, but he is dangerous as a railroad man and ought not to be so employed. He and his kind have made the following record:

During the first year-period ending June, 1910, 1976 derailments were caused by the negligence of trainmen and switchmen. In these derailments 263 persons were killed and 2,264 persons were injured. Such accidents are always preventable. They are the product of hopeless imbecility on the part of the delinquents and of incompetence on the part of the officials who hire such men. The character has been denounced severely, but too little has been said about the official who gave the accident producer his opportunity.

The employee who leaves a switch open, or who fails to flag properly, thereby causing a disastrous accident, is brought into unenviable notoriety; but other acts of gross carelessness, resulting in loss of life, never get home to the guilty party. A wiper discovers a crack in a side rod and says nothing about it, and he scarcely feels guilty when the breakage of that rod next day leads to the death of several persons. A car inspector discovers a loose ladder-tread or a loose handhold and passes them without repair, with the result that a brakeman a thousand miles away falls to his death. Unfortunately the murderer escapes detection.

The inspectors of the Interstate Commerce Commission have detected many defects left dangerous by careless workmen. Derails have been found outside of the boiling point on side tracks. Signals have been found connected by wire in such a way that a broken wire would put the signal into the clear position. On one road it was found that the signal protecting a drawbridge could be set "clear" when the draw was open. Inspectors who insisted on doing their work thoroughly have found boiler beams so badly corroded that an explosion was not far off had the defect been neglected a few weeks longer.

The real remedy for all this is greater keenness on the part of the officials responsible for hiring railroad help.

Effect of Varying Loads.

The statement has been made that to insure long life to a steel bar taxed by repeated applications of a load, it is absolutely necessary that the working strain should be considerably smaller than is usually considered permissible with a steady load.

The safe load which a structure will bear depends not only on the proportion

which the safe load bears to the breaking load, but on the number of times the load is applied and released. A brest-summer that will sustain for years a steady load of an immense pile of bricks and mortar, would soon give way under the constant repetition of strains to which the girders of the elevated railroads are subjected, though the trains might weigh considerably less than the building.

Reliable experiments and experience have shown that as the continual dropping of water will wear away the hardest stone, so the continual repetition of even a moderate load will fracture the best steel. As we decrease the load, the life of the structure increases. A steel axle will stand some hundred thousand repeated applications of a given load, say one-third the breaking load. The load when decreased to one-fourth the breaking load, can be applied two or three million times, and as the load is further decreased the number of applications can be increased until a really safe life is reached.

Many will at first sight be inclined to believe that this is already obtained if a piston-rod or axle or crankpin will stand 3,000,000 repetitions of the ordinary working strain before breaking. A simplex calculation will show the fallacy of this motion. A Consolidation engine with 48 in. drivers makes 420 revolutions in running one mile, and will, therefore, make 3,000,000 revolutions in running 7,143 miles only. We imagine few of our readers would relish renewing their axles, etc., after such a very short mileage, and would prefer something which they could be tolerably sure would not break under at least 100,000 miles. This, however, means 42,000,000 repetitions and reversals of strains on axles, crankpins, and piston rods.

It is evident that under the circumstances the ability to stand repeated strains becomes of supreme importance. That these requirements can be amply met, is shown by the fact that there are numerous steel driving axles which, under heavy engines and under trying conditions, have run 400,000 miles. Our own experience is that it is not impossible or even difficult to obtain steel axles, crankpins, coupling rods and piston rods that are practically absolutely secure against breakage in service, their life being only limited by wear due either to dust or occasional deficient lubrication.

Converted to Favor the Brick Arch.

The writer has always had a high opinion of the economical value of the brick arch in locomotive fireboxes, and ever since his voice carried any authority he has advocated the use of the brick arch in season and out of season. As long ago as 1885 he was preaching to master mechanics about the cost they might save by using the brick arch, but it was a voice crying in the wilderness where few would listen.

One of the most influential opponents of the brick arch in the long ago was James N. Lauder, superintendent of rolling stock of the Old Colony Railroad. The writer wrested with Lauder every time they met about the value of the brick and ultimately the superintendent of rolling stock yielded. The case resembled that of the Unjust Judge who did justice to the widow lest her importunities weary him.

Lauder took two locomotives of the same general proportions and put them pulling alternately a train about the same weight, one engine being equipped with the brick arch the other having a plain firebox. Strict attention was devoted to the coal records of both engines. They ran opposite each other for two months, and care was taken that no extra work was done by either of the engines that would vitiate the value of the recorded fuel performance. For the first month the engine with the plain firebox ran 50.87 miles to the ton of coal, while the engine with the brick arch made 58.22 miles to the ton of coal. That proportion kept up in subsequent months with the result that Mr. Lauder became a convert to the economy resulting from the use of the brick arch and applied it to most of the passenger engines belonging to the Old Colony Railroad.

Mysteries of Breakages.

Some years ago the subject of "broken piston rods" was under discussion and the statement was made, that fracture very often happened, not at the apparently weakest spot on the point of least section, although none of the fractures originated far from the point, which ought to have offered the least resistance. At first sight it might seem to show that the existence of weak spots and sudden changes of section is not the real cause of these fractures. That this hasty assumption is erroneous may be proved by several different methods. In the first place, the fracture can be altogether prevented by strengthening the weak spots, and by abolishing square-cornered shoulders or other sudden changes of section. This has been done in innumerable cases all the world over, and as the strains are the same and the material is the same, the only change being in the design, the alteration in form has evidently effected the curve.

Another reason is that statistics on a large scale show that structures under constantly repeated strains do not always or even in the majority of cases, break exactly through the weak spot. The fracture is generally a little distance away. In an interesting paper read several years ago before the Institution of Civil Engineers, the author showed that a method prevalent in Europe of securing tires to the body of the wheel by means of a rivet through the tread of the tire was dangerous. Tires weakened by this rivet-hole broke far more frequently than plain tires. But, strangely enough, in six cases out of ten, the tires broke through the solid part of the tire and not through the rivet hole. The author of the paper gives his reasons for this apparently erratic behavior of several hundred tires, and we only regret that his chain of reasoning is too long to reproduce here. We may, however, derive two important practical lessons from the facts which he collected. Weak spots will cause the failure of a tire or axle, though the fracture may not take place exactly through the weak spot, and conversely the fact that a fracture takes place *near* and not *through* a key way or other weak spot, should not blind us to the fact that the key way did the mischief.

Sudden reductions of area should be avoided in structures made of wrought iron and subjected to a tolerably steady load. The question, however, becomes of vital importance when steel is used in a locomotive, the working parts of which are specially subjected to an enormous number of repetitions of suddenly applied loads from different directions. The great number of repeated applications of a load has long been presented practically to those in charge of locomotives, though the exact significance of the breakage of working parts has been somewhat obscured by the tendency to regard the crystallization of wrought iron as a thing which, like old age, is inevitable, if life lasts long enough. As steel is crystalline to start with, some other explanation must be sought when a steel axle fails. Experimentalists and scientists long ago discovered that a bar of iron or steel could be broken in a comparatively short time by the repeated application of a moderate load.

Methods of Firing.

Honor is frequently earned; at other times it is thrust upon people without merit or price. This has been the case with our chief editor in relation to what is known as the one shovel method of firing. In a conversation he had lately with Mr. W. S. Carter, of the Firemen's Brotherhood, our chief was given to understand that he is the reported author of the one-shovel method of firing, and he disclaims the honor. Here is his description of the methods of a first-class fireman, published in his book, "Locomotive Engine Running," in 1884, and continued through all the editions of the book. That is the Sinclair method of firing:

"Ours is a model train, and a model fireman furnishes the power to keep it go-

ing. He throws in four or five shovelfuls at each firing, scattering the coal along the sides of the firebox, shooting a shower close to the flue-sheet, and dropping the required quantity under the door. With the quick intuition of a man thoroughly master of his business, our model fireman perceives at a glance, on opening the door, where the thinnest spots are; and they are promptly bedded over. The glowing, incandescent mass of fire, which shines with a blinding light that rivals the sun's rays, dazzles the eyes of the novice, who sees in the firebox only a chaotic gleam; but the experienced fireman looks into the resplendent glare, and reads its needs or its perfections.

The fire is maintained nearly level; but the coal is supplied so that the sides and corners are well filled, for there the liability to drawing air is most imminent. With this system closely followed, there is no difficulty experienced in keeping up a steady head of steam. But constant attention must be bestowed upon his work by the fireman. From the time he reaches the engine until the hostler takes charge at the end of the journey, he attends to his work, and to that alone; and by this means he has earned the reputation of being one of the best firemen on the road. His rule is to keep the fire up equal to the work the engine has to do, never letting it run low before being replenished, never throwing in more coal than the keeping up of steam calls for. The coal is broken up moderately fine, a full supply being prepared before the fire-door is opened; and every shovelful is scattered in a thin shower over the fire—never pitched down on one spot. Some men acquire the art of scattering the coal as it leaves the shovel! and, as a result, they never succeed in making an engine steam regularly. Their fire consists of a series of coal-heaps. Under these heaps, clinkers are prematurely formed; and between them spaces are created, through which cold air comes, and rushes straight for the flues, without assimilating with the gases of combustion, as every breath of air which enters the firebox ought to do.

Genteel and Other Occupations.

The spirit of the American day school is exercising a very penicious effect upon our industrial life, by leading boys to believe that no kind of labor is worthy of their attention except work of a genteel character. Modern teaching makes out that an occupation where a person is not required to soil his hands is much more desirable than that of a sooty-handed mechanic. It is this sentiment that has induced not a few good mechanics to desert the machine shop for work in shop and offices.

When a young man voluntarily gives up a steady position in a machine shop where he is earning good wages, for an office position at half the wages, simply because he considers the latter the most respectable, there is evidently something wrong with his early education or with the society from which he gets his ideas of respectability. To use the homely old adage, "he pays dear for his whistle," and will find as he grows older that the luxury of clean hands and white shirt on week days is of small account, when compared with the luxury of that independence which come of being the master of a good trade, albeit it is generally considered a dirty one.

The writer can look back to the knowledge gained through his early service in a machine shop as the foundation of whatever prosperity has since come to him, and doubtless thousands of others now holding responsible positions can do the same. If the apprentice looks upon learning his trade simply as an end to be gained, and to standing at the vice or by the lathe or planer as his life work, we do not wonder at his becoming disheartened and wishing to abandon it; but if he looks at his trade as he should, as something full of possibilities, and a stepping stone to a wider and more active field of usefulness, he will not regret or murmur at whatever of unpleasantness or inconvenience may attend it. The owners of many of the largest and most important manufacturing establishments in the country have built them up and made them successful because they were masters of their trade, and because they were independent by reason of such mastery. Every step in advance brings with it added responsibilities, and no matter whether in machine shop or out of it the boy who is looking for some easy road to respectability will surely be disappointed.

Positively the First Railway.

Stockton and Darlington are two towns in the county of Durham, England, that deserve the veneration of railway people, for to connect their trade interests the first real railway in the world was put into operation. The Stockton & Darlington Railway, twelve miles in length, was opened in 1825, with George Stephenson as chief engineer and energetic promoter.

The construction of the Stockton & Darlington Railway was nearly frustrated by the opposition of the Duke of Cleveland, who tried to block the enterprise, because the proposed line passed near one of his fox covers. By making an extreme detour that left the foxes in quiet possession of their haunts, the opposition of the sporting duke was overcome and the line built, after much delay.

In 1821 an act of Parliament was passed providing for the making and maintaining of tramroads for the passage of wagons and other carriages with men and horses or otherwise. The public were to be free "to use with horses, cattle and carriages" the roads formed by the Stockton & Darlington Company, on paying authorized rates.

Through the influence of George Stephenson, locomotives were used in place of "horses or cattle." The starting of the first train was a great public spectacle that proved more attractive than any circus had ever been. Stephenson ran the engine and had a horseman with a red flag ride in front to warn pedestrians of what they might expect if they failed to keep clear of the "fire engine," as the locomotive was then called. The practice of running a horseman in front of the locomotive was soon abandoned, but that ancient feature is still in vogue in New York City in connection with cars running on West street.

Standard Screw Threads.

"Accurate knowledge is a plant of remarkably slow growth," was a thought forced upon us by finding on our desk a letter from a correspondent asking the difference betwen Standard screw threads and Sellers screw threads? It was a wonder that our correspondent did not also ask about the Franklin Institute screw threads.

There is only one system of screw threads used as standard in the United States, viz.: The system of United States standard screw threads, which was devised by William Sellers of Philadelphia and was adopted by the Franklin Institute, on the recommendation of a committee appointed by that institute to investigate the subject of screw threads. The Franklin Institute performed important services to the industries of the United States by spreading widely publicity of the system devised by Mr. Sellers. The adoption of a uniform system of screw threads put an end to great confusion, for nearly every engineering establishment in the country was promulgating its own system of screw threads, guaranteed to be interchangeable with no other system.

In 1868 the Chief of the Bureau of Steam Engineering of the United States Navy reported in favor of the system of screw threads devised by William Sellers being adopted as standard by the United States navy, and his recommendations were carried out. Various engineering societies and manufacturing establishments shortly afterwards adopted the Sellers system of screw threads, and it became known as the United States Standard to distinguish it from the Whitworth system used in Europe. Railroads were slow to favor uniform screw threads, although no interest could secure greater benefit from them. The Erie Railroad Company adopted the United States Standard screw threads and their example was soon followed by other roads. In 1871 the Master Car Builders in convention adopted the United States Standard system of screw threads as a

standard of the association which gave it a rapid move into popularity.

The annual reports of the Railway Master Mechanics' Association and the Master Car Builders' Association contain particulars of the United States standard screw threads, and so do all engineering hand books, so there is no scarcity of references. Familiarity with the dimensions of the United States standard screw threads ought to be an essential requirement on the part of every mechanic who works on metal, and men in charge of such work ought to be ashamed to acknowledge ignorance of a subject of so much importance in the interests of mechanical accuracy.

The Right to Drink.

Speaking of the order issued by the managers of the Delaware, Lackawanna & Western Railroad to the employees in the transportation service that they must abstain from intoxicants "on duty or off," says the New York *Tribune*, a New York retired merchant told this story: "My father made the same rule in his business many years ago. When I left school and went to work for him I knew of the existence of the 'temperance rule,' as it was called, and thought it a perfectly good one. I had not been a total abstainer, but was always temperate, and one evening at a social gathering, at which my father was present, I joined the men in a drink. My father heard of it, and next day I was discharged. 'It would be death to discipline if you remained,' my father said. I made a trip, came back and was re-engaged, and have never since that time taken a drink."

Very radical changes of opinion about the right of railway men to take a drink when they want to has grown since what is talked of as the "good old times." It used to be that train men considered it a tyrannical interference with their personal liberty to say that they should not take a drink of beer or whiskey when they felt so disposed, but all of that class has had to acknowledge the right of the employers to insist that persons connected with the movement of trains shall abstain from swallowing anything likely to mar their judgment or interfere with the keenness of their vision. The change in this respect has been radical on the American continent, but it has been more radical in European countries.

In the British Isles where drinking used to be claimed as a right, laws have been passed which makes it a crime for railway men to enter drinking places at any time. The striking things about this change of sentiment is that the law guardians find it their duty to arrest railway men found violating the laws that restrict drinking.

Artificial Rubber.

Those familiar with chemistry are inclined to believe that almost any product of nature can be reproduced artificially by mixing the exact combining elements. For some reason many attempts have been made to produce artificial rubber and readers of American technical journals are familiar with attempts in that line. Our Glasgow representative, Mr. A. F. Sinclair, who is a staff contributor to the Glasgow *Herald* has recently discussed a Synthetic Rubber Discovery as follows:

"The very interesting experiments described in the Glasgow *Herald* of June 26, by which it is claimed that synthetic rubber equal in quality to the natural article can be produced, has caused no little agitation in certain financial circles, but it is very questionable whether any real cause for anxiety exists. This is not the first time by many that we have had it intimated that a substance had been discovered which would send real rubber into a back street. Just the other day we were told that our morning haddie would cost us more because an extremely erudite scientist had discovered that rubber equal to the best Para could be made from fish. Synthetic rubber may be placed on the same level (when compared with the real article) as spring wheels and filled tyres are situated in relation to pneumatics—but with this difference, that artificial rubber may possibly be evolved some time, but the spring wheel and other substitutes can never in the nature of things equal the air filled tube. It would be unwise to dogmatize against the success of the more recent rubber substitute. With synthetic dyes beating the natural articles out of the market, to mention only one kind of manufacture by synthesis, it would be unwise to be positive for or against.

But there is quite a difference between producing a substance by synthesis which on analysis shall be found to consist of the same elements in the same proportions as rubber and quite another thing to obtain equal results in use from the substitute as from the real article. It would have been much more convincing had Professor Perkin and his most learned coadjutors left over their very interesting statement until a trial of the article had been conducted by some qualified and unprejudiced body without knowledge of its character. It will be remembered that some time ago a Kiel professor discovered an article which had been subjected to severe laboratory tests and had come through them so triumphantly that a syndicate with a huge capital was formed to exploit it. The same story came from America on another occasion, as well as from Moscow, from Stockholm, even London gave us a previous inventor of synthetic rubber which was to perform all the offices, to fulfil all the uses of the real natural article. And where are they all today? "Gone, and left no address." The newcomer may be the real article, but it will be time enough to accept it as such when it has passed through practical tests.

Long Lived Locomotive Engineers.

In addressing the Conference Committee of Managers who were investigating the question of increased pay for engineers Mr. W. W. Atterbury, vice president of the Pennsylvania, submitted an array of interesting statistics, among them figures which showed that engineers on the Pennsylvania Railroad live longer than any other class of employees. "As an actual fact," he said, "we have 202 engineers on the pension roll—7.6 per cent. of the pensioned employees are engineers and they are drawing 12 per cent. of the pensions. The average amount paid to all pensioned employees per month is $23.95; the engineers' average is $41.35.

"The average length of service of engineers, of those men who died from natural causes, was 21 years, and the average length of service as engineer of those who died as a result of accident was 13 years, and the average length of service of the enginemen of all men who died was 18.

"It is rather curious and it is exceedingly interesting," said Mr. Atterbury, "to note that the average age at death of all classes of our employees, officers and everyone else, was 49, as against 51 for the engineers and for those the average age at death, as the result of accident, was 33, for all, as against 42 for engineers.

In other words, apparently the engineer's length of life is longer than that of any other of the railway employees of which any record is kept.

This is entirely different from the popular belief respecting mortality among locomotive engineers, who are considered a short-lived class, an impression that no doubt comes from want of accurate information.

The Canadian Northern's improvements in the vicinity of Toronto, will amount to many millions of dollars. They will include the new yards and shops at Leaside Junction, a handsome 12-story office building in Toronto to house the head offices of the company, the new Yonge street station, and the North End viaduct. Besides these works the company will have large yards and shops at Port Mann, British Columbia; smaller shops and yards on the Rideau River, near Ottawa.

Catechism of Railroad Operation

By Angus Sinclair

Questions and Answers.
Second Series.

(*Continued from page 290.*)

213. How many forms of injectors are you familiar with?

A. Lifting, non-lifting and restarting.

214. Is there any seeming paradox in the operation of an injector?

A. There is something strange in having a jet of steam to force water into a boiler against the pressure that the actuating jet was drawn from.

215. On what principle does the injector operate?

A. The principle on which the injector works is a combination of forces, velocity of steam creating an induced current of water which passes through suitably proportioned tapered tubes called steam nozzles, combining tube and delivery nozzle. The steam nozzle partly enters the combining tube, but leaves an annular space through which water enters and is condensed, at the same time receiving impetus from the steam, which is of sufficient force to push it inside the boiler, overcoming the resistance met at the check valve.

With a lifting injector a small volume of steam is passed through the combining tube, which forces the air through the overflow pipe, producing a partial vacuum in the suction pipe, which is quickly filled by water from the tank, putting the injector into action. The next move is to open the steam valve, permitting the steam to enter the combining tube at a high velocity, imparting its force to the water. Leaving the combining tube, the feed water, increased in volume by the condensed steam, rushes through the delivery nozzle into the branch pipe, thence through the check valve into the boiler. Double tube injectors have one set of tubes for lifting the water and delivering it to the second set, which are the forcing tubes.

216. On what principle does a non-lifting injector work?

A. The principal difference between a lifting and non-lifting injector is that in the latter the water flows into the combining tubes by gravity, no provision for lifting the water being necessary.

217. What are the peculiarities of a restarting injector?

A. The leading peculiarity of a restarting injector is that it has very large overflow openings, which serve to maintain or re-create the vacuum when an injector breaks. This action is automatic and is a valuable feature of an injector.

218. What is generally the cause of the second injector on an engine failing to operate?

A. Some engineers depend so much upon one injector that the spare one is rarely used and falls out of working order through neglect. This defect can be obviated by making it a rule to operate the second injector frequently during every trip.

219. What are the advantages of the combination boiler check?

A. It reduces the number of holes in the boiler and tends to reduce injector failures. Another good feature about a combination check is that it is generally fitted with a globe valve that is independent of the boiler check valve and can be closed when necessary. This enables workmen to grind the check valve or effect other repairs when the engine has steam in the boiler. It also enables the engineer to examine and relieve a stuck check valve.

220. If both injectors stop working on the road, what can be done?

A. Would first ascertain the cause before attempting a remedy. Would first find out that no obstruction was preventing the water from reaching the suction pipe or the water in the tender was not too hot for the injector to operate. Would examine strainer very carefully and find out if the tank valve opened properly, and that the feed pipes were free from leaks.

221. If the injector primed and broke when the full supply of steam was applied, what would you do?

A. Would look for trouble in the delivery tube, in the branch pipe or in the check valve.

222. How can a disconnected tank valve be opened without stopping?

A. By closing the heater valve and forcing steam from injector back into tank to dislodge valve.

223. Is there any other cause that would prevent injectors from working?

A. If the lid of the tank fitted airtight, the vacuum formed when water was drawn out would stop the flow of water. In frosty weather tank lids that are loose at other times become airtight through the formation of ice.

224. What is the most common cause of both injectors failing to work?

A. An empty tank.

225. What generally happens when sand or dirt gets into the injector?

A. It stops working.

226. What is the remedy for that trouble?

A. Take the tubes apart or remove the cause of trouble. Sometimes sand or other matter may be removed by repeated attempts to start the injector.

227. In case the boiler check sticks up and hot water begins to flow back through the branch pipe, what should be done?

A. Jar the check seat with a piece of wood which will generally cause the valve to settle in its place. If the valve fails to seat tight, something has passed through the delivery pipe that is keeping the valve from closing properly. If the engine has a combination check, it can be closed and the steam shut off from the check valve, giving the opportunity for removing any substance that may be preventing the check valve from seating.

228. Will an injector work, if there is not sufficient water flowing to condense all the steam?

A. Unless there is sufficient water to condense the whole of the steam entering the combining tube the injector will work badly. It requires a solid stream of water to force itself through the check valve against the steam pressure inside the boiler. When the stream is not solid the steam part spatters and tends to escape through the overflow, frequently making the injector to break.

229. What is the remedy for that trouble?

A. Cutting off part of the steam by partly closing the injector throttle. It is generally the better plan to keep the injector throttle partly closed, admitting just enough steam to keep the injector working with regularity.

230. Should an injector be worked continuously, or shut off when starting, after making a stop?

A. There is some conflict of opinion on this question among the best authorities. Many engineers keep the injector at work constantly, regulating the supply to suit the work. For the Traveling Engineers, Secretary Thompson says: "Shut off the injector at the time the throttle is opened to start the engine, and start the injector as soon as the lever is hooked up after the train is under way, or as soon as steam pressure begins to rise after pulling out, taking care to have a proper supply of water in the boiler at all times. By this method the steam pressure can be held regular and be highest just when needed to get the train under way quickly. When pulling out after a stop, steam pressure should be

held up against the large amount being used by the cylinders, and the fresh coal being put on the fire that has not been burning fiercely while the steam was shut off, so it does not give off a full supply of heat. If to this you add the steam used by the injector as the supply of feed water that must be heated, the pressure will surely drop. As the water rises, with some engines, when the throttle is opened, it is an advantage to ease or shut off the injector for a minute or two when pulling out and keep it at work after shutting off while the fire is still burning fiercely and thus utilize the heat that would make the boiler blow off steam."

231. What is the general practice of good engineers in regard to carrying water in the boiler?

A. To carry sufficient water to have the heating surface covered under all conditions of working. Would carry the water level as close as practicable to the point where priming would begin without reaching that point.

NOTE:—With next issue of RAILWAY LOCOMOTIVE ENGINEERING we will begin publishing a series of articles on Mallet-Locomotives, by Mr. F. P. Roesch, master mechanic of the El Paso & Southwestern, who is very familiar with that form of engine and is an admirable writer. We are sure that the articles from Mr. Roesch will be read with pleasure and profit by all those interested in the latest development of the locomotive engine.

Performance of Wood Working Machinery.

When a machinist watches a metal working tool slicing off iron and steel with as much ease as if the material worked upon were cheese, he has less than common admiration for wood working tools that put their mark upon lumber; but he would have more respect for wood working machinery if he could figure out particulars of the work they perform.

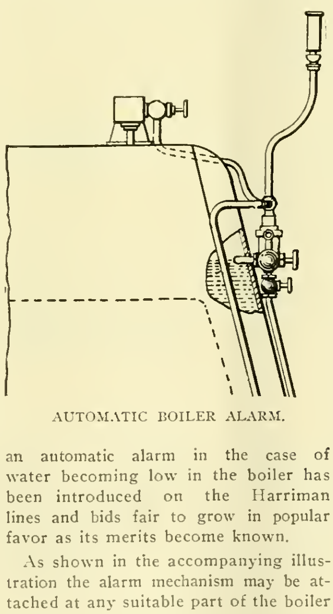
We have had occasion in times gone by to note experiments made with wood working machinery, and surprising information was obtained concerning the amount of power required to do the work. For example, a 12-in. matcher running on 6-in. spruce called for nearly 15¼ horse power. The same machine running empty required 10 horse power to keep it going. It required the equivalent of 32.2 horse power, or 1,062,600 foot-pounds, to start a 24-in. double surface planer; but after full speed had been attained, the power fell off to 12.48 horse power, or 411,840 foot-pounds. In other words, nearly 19 horse power extras was required while the planer was being started than what was needed to keep it running. It was the equivalent of the extra power which a locomotive must exert in starting a train and lifting it into speed.

A 14-in. rip saw, cutting 1-in. stuff, called for 5⅓ horse power, which is almost the same as that required by a circular resawing machine splitting 6-in. pine, and varies but a small fraction over the power required by a 60-in. circular resawing machine.

It is not so long ago since all the lumber cutting by these machines was all done by hand. It would be an interesting problem to figure out how many men it would have taken to execute the work turned out by the machines mentioned, allowing 12 men for one horse power.

Automatic Boiler Alarm.

Among the more important recent inventions in relation to railroad appliances it is interesting to note that a safety apparatus designed to produce



AUTOMATIC BOILER ALARM.

an automatic alarm in the case of water becoming low in the boiler has been introduced on the Harriman lines and bids fair to grow in popular favor as its merits become known.

As shown in the accompanying illustration the alarm mechanism may be attached at any suitable part of the boiler head. The apparatus consists of a cylinder having a single port communicating with a steam boiler at the low water level, and the cylinder may admit both water and steam, and in the event of the water becoming low in the boiler the water that may have found its way into the cylinder is discharged into the boiler as soon as the water in the boiler falls below the point of admission into the cylinder. A separate receptacle or cup is formed inside the cylinder, and a quantity of mercury is retained in the inner cup. When the water falls away from the inner shell of the cylinder the mercury expands and actuates a valve having a depending stem, a piston in the casing above the expansive liquid engaging the valve stem and having means to admit steam into an attached whistle, thereby giving warning that the water had fallen below the point at which the device is attached and which is assumed to be the low water mark, or safety line, beneath which the water should not be allowed to fall.

The apparatus is said to be perfectly reliable and a number of locomotives on the Harriman lines have been equipped with the device. The apparatus is the invention of Mr. Harry Neville, Los Angeles, Cal., and a number of prominent railway men in the West have interested themselves in the device, which, they are assured, cannot fail to come rapidly into use.

Good on the Part of the Diamond Match Co.

There has been much agitation both in Europe and America for the discontinuance of white phosphorus in the manufacture of matches, because of the hardship on the part of the operatives in the factories, which is claimed to follow its use. Abroad the thing has been nearly stamped out. In England since 1910 there has been a law forbidding the importation or sale in England of matches containing white phosphorus. It is said that the double dip or double tip match, which burns so quickly and so well, and is so popular in the United States is more detrimental to the workers in the factories than the matches whose manufacture was prohibited in England. President Taft not long ago recommended in a message that a heavy tax be put on matches made with white phosphorus in order to discourage their manufacture; and the Diamond Match Company has apparently done a fine thing for the protection of the match factory operatives everywhere in the country, by making it possible for all manufacturers to turn out a safe product.

The Diamond company held the patent for tetra-phosphorus trisulphide, which is apparently the only successful substitute for white sulphur. In order to leave the field free to all, they have lately surrendered their patents on this material, and now no manufacturer has an excuse for using white phosphorus. It is said by the Journal of the Society of Chemical Industry that this action, followed by a tax on the white phosphorus match, would serve to put an end to this evil in the United States. Here is certainly an act of notable philanthropic spirit, a sacrifice far reaching not only in its immediate effects, but as an example of a stand against cruel greed in modern industry.

Railway Signaling

Several years before this discussion took place a signal with its blade moving upward had been suggested for mechanical reasons. This scheme had been used in Germany for some time and had the advantage that no counter weight was necessary to bring the blade to the

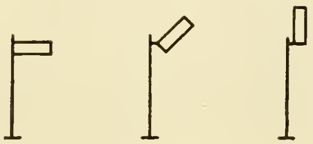


FIG. 16.

stop position. From an indication standpoint the three-position signal was acknowledged to be the best, because three indications were available at each signal with a single arm and because the indication given by the arm in a vertical position upward was so much more distinctive than if the blade moved downward it seems quite logical, therefore, to adopt what is now called the three-position upper-quadrant signal, Fig. 16, as a basis.

At this time the colors of the night indications were changed, red indicating stop, yellow caution, and green proceed. So that we will start on the analysis of the discussions with these three bases:

1. Signals are used to indicate what is required of the engineman in the control of his train.
2. Three-position upper-quadrant signals will be used for day indications.
3. For night indications red will indicate stop, yellow caution, green proceed.

The table of indications was revised and presented to the Railway Signal Association in 1908 and in 1909 to the American Railway Engineering Association. The indications are shown in the accompanying table. It will be understood that the letters R, G, and Y indicate the red, green and yellow lights or signals displayed. It will also be noted that aspects giving instructions to be obeyed at the signal are given by the top arm, and that, when it becomes necessary to give information about the next signal, this is done by actually adding a blade to act as a true indicator.

Note also that, as the indications pass from "Stop" (the most restrictive indication) to "Proceed at normal speed; prepare to pass next signal at normal speed" (the least restrictive), red gradually is eliminated and yellow or green is introduced till two greens are displayed for "All clear."

These aspects did not find favor because of the radical change it was claimed of indicating speeds by the position of one arm, as in Fig. 17, instead of by the location of arms on a mast, as in Fig. 18. They had not yet forgotten routes and still stuck to the three-arm route signal to indicate speeds.

Remembering that red indicates "stop," yellow "caution" and green "proceed," it will be noted in the Table that there are two reds displayed in A. Why is not one sufficient? In C green and red are displayed. What will the engineman do? Apparently there is no necessity for him to stop, and, if the next signal is at stop, he cannot run at normal speed very far. Is not caution intended, and, if so, why not a single yellow light?

In D green and yellow are displayed. With this aspect it is true the engineman may run a little farther under normal speed than when C is displayed, but the saving of time will be very slight, and a single yellow light will take care of this very nicely.

In E there is the same duplication of green lights as there is of reds in A.

In G yellow and red are displayed. No argument is necessary to show that cautious running is required, and therefore the yellow light is all that is necessary.

In H there is a duplication of yellow lights. One will do.

In K yellow and green are displayed. Yellow is the only color which can be obeyed safely under this indication.

The same analysis of the indications can be made. When will an engineman stop proceeding at normal speed and start preparing to stop at next signal? When will he stop proceeding at limited speed and start preparing to pass the next signal at normal speed? And so on throughout. It is evident that we can replace A with a single red light; C, D, G, H and K with a single yellow light, and E with a single green light, reducing the main indications and aspects to three, as shown in Fig. 19.

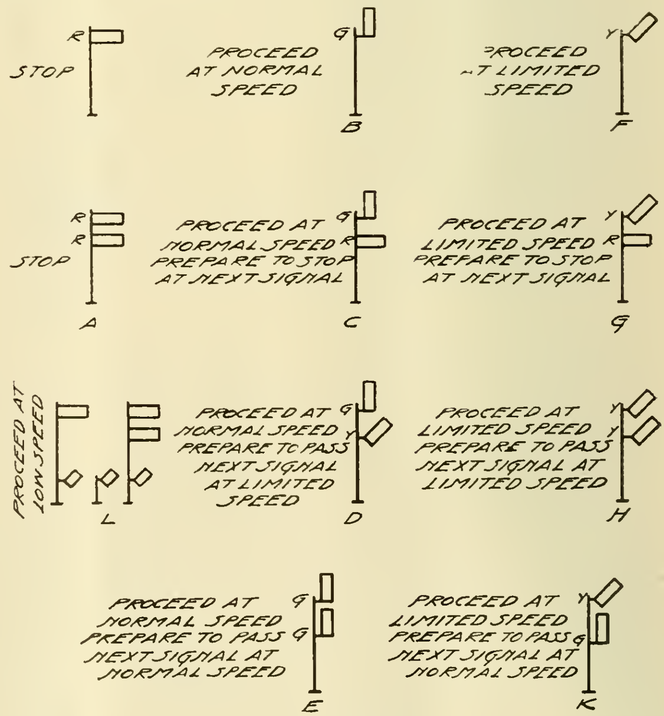


TABLE OF INDICATIONS.

These arguments may sound silly to the old-timer who has been used to running safely under all kinds of signals, but they represent the exact process which, curiously enough, brought about a vindi-

cation of the three original code indications, "stop," "caution" and "proceed."

What becomes of slow speed or of the dwarf signal by itself or at the foot of a high signal? How much difference is there between slow speed in a practical way and running under control? The indication is of use sometimes when signaling into a short siding, where a very slow switching speed may be desirable, but ordinarily the time that would be lost by a train running at a safe speed under control through a switching locality so as to make it safe to enter any switch is so small as not to warrant the complications necessary to give the slight difference which may at infrequent intervals

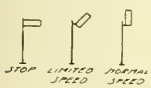


FIG. 17.

FIG. 18.

exist between under control and slow speed.

What of routes? There are places where it is very advisable that trains shall know what tracks they are to run on. Sometimes, where many sidings are mixed up with a junction, it must be a help to the engineman to know that the route is right. Where trains leave a joint track it is necessary that men should know they are going onto the right track, and there are many other points where it is reasonable to suppose that enginemen will feel more comfortable if they can see that the way they ought to take is set up.

How shall we do this? We have seen that true route signaling from a central point, where each route is signaled by a separate blade, means complications for the high speed man or complications for the man who has to remember to what route the blades refer. If the routes are grouped into limited and low speed routes we have lost route signaling and developed speed signaling, producing two very finely graded caution indications. Neither of these seems satisfactory because of its complications and the large number of red lights necessary.

If the track a man is to be signaled onto is important (a branch or another main line) it is not sufficient that he should know that the right blade is indicating proceed, but he must know where the switch leading to the track is located, and, after he has passed the switch, he must know he is on the right line. No matter how much we try we cannot relieve him of this. Then why not use the switch itself through the medium of the target and light as the route indication—an indication of the actual condition of the thing the man wants to use, not an arbitrary representation?

But, some say, "You'll be running men into a junction against a red light." Well, they have done this before signals were invented, when some friendly fellow employee set the switch, but if a point is properly signaled and a caution signal displayed some distance from the switch, there is no need for a red light. Green for the main line and yellow for the sidings seems ideal.

This, then, is the signaling which has resulted in the entire elimination of the display of red at any time when it does not mean stop; stop, caution and proceed displayed by a one-arm signal, as in Fig. 17, for the control of the train, switch targets or lights displaying green for main line and yellow for siding for route indications.

So far we have discussed only the caution indication where interlockings are concerned or where there is another signal ahead of the one passed.

If a system of signals is started by giving specific information about conditions requiring cautious running there must be designed an indication and aspect for each condition, such as, "Next signal at stop," "Switch set for siding," "Nineteen orders to deliver," "Train in block," and as many others as can be protected against. Each one must be indicated by a specific combination of arms or lights, and the whole of these combinations may be displayed at one time.

No matter how carefully we may design our signals; no matter how far the development of signals is carried in the future, we never shall be able to relieve the engineman of the duty of supervising the road over which he is running. This being true, is it not a fact that the careful man who is attending to this obvious duty will see all these things we are try-

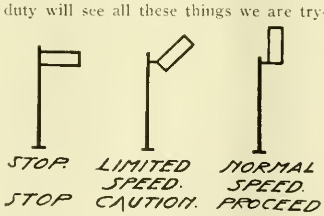


FIG. 19.

ing to tell him about and that, if he is running slowly enough, will stop before reaching them or run so slowly that the movement will be safe?

We cannot wake men by signal. We only can help the careful, loyal man to make time by doing our best to assure him that, when necessity arises, we shall either tell him to stop or to run at limited speed (under control) according to the nature of the obstruction.

The Railway Educational Association, Monroe street, Brooklyn, N. Y., have issued an illustrated booklet giving records of successful graduates. It is sent free on application and makes interesting reading for young men ambitious to rise in the railroad world.

Modern White Elephants.

Not long ago a locomotive engineer, who had operated one switch engine in one railroad yard for about a quarter of a century, was retired to the pension list, says the *Valve World*, and as a mark of uncommon consideration he was presented with the locomotive.

What a fitting reward for long and faithful service and how beautifully the example might be followed by all employers.

Can't you picture the delight and pride of that old engineer as he trundles his locomotive about with him and shows it to his friends? I fancy him playing with it out in the back yard in the evening, and, to paraphrase Goldsmith's soldier, entering his cab and showing how tracks were run.

The custom ought to be extended. Let the reward for long and faithful service be a present of the machine the faithful servant has operated. Let it be the point he has guarded. Give the stationary engineer his engine, the crossing man his gates, the section boss his section, etc.

On a recent trip West I saw a number of abandoned tunnels. I was told that one old man, living in a little shack on the banks of the Columbia, had acted as guard at one end of one of those old tunnels for most of his long life. How fitting, I thought, would it be to give the old man his tunnel. He could use it as a cave or he could cut it into sections and build himself a larger home, or he could pull it out, put a keel on it and use it for a boat. There is no end to the uses to which a tunnel may be put by one who has had long acquaintance with it and knows all about handling it.

As an individual, and one who earnestly believes in rewarding long and faithful service, I hope to see a rapid extension of the excellent example set by the company that gladdened the heart of that old engineer by making him a present of a switch engine.

Only I should have added enough of track and roadbed to make the thing worth while.

Searchlights.

What is said to be one of the strongest searchlights in existence has recently been placed on the roof of the Bank of International Pensions, Plaza Libertad, Montevideo. Consul Frederic W. Goding, of that city, states that the candlepower is 90,000,000. The light can be seen eleven miles and illuminates every portion of the city.

No man is long a reformer, for wisdom sees plainly that growth is steady, sure, and neither rejects what is, or has been; whereas reform is organized distrust, and lacks the quality of endurance.

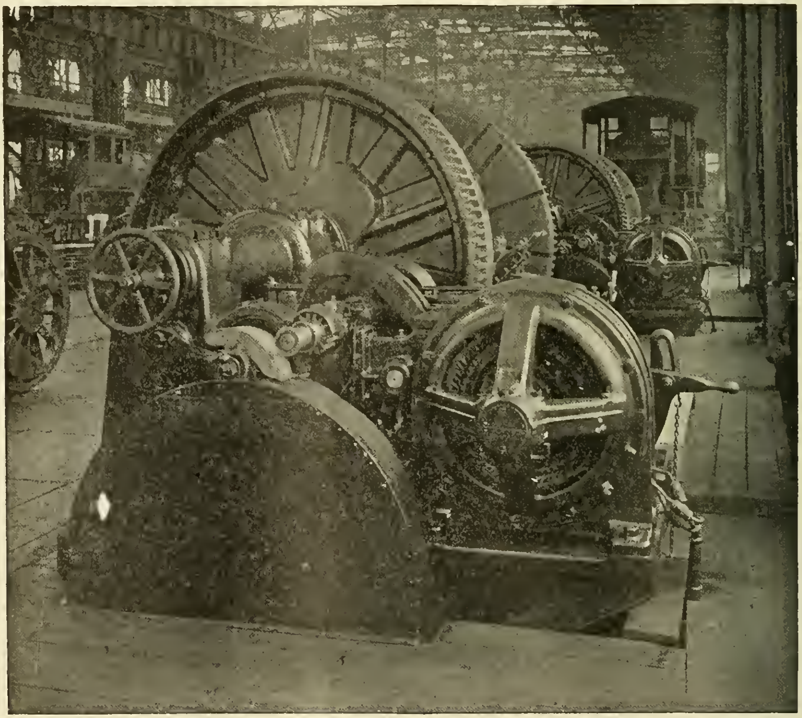
Electrical Department

Motor Drive for Railroad Repair Shops.

The advantages of electric motor drive applied to machines and tools in shop operation have been firmly established in practice. It is rare indeed that railroad repair shops are designed nowadays without providing for electrical operation of the machinery, and the tendency to modernize older existing shops by making the necessary changes to arrange for driving throughout by motors is increasing. Convenience, simplicity, economy of operation, increased output, better light and safety are some of the many benefits resulting from electric drive.

It permits the power to be centralized. The electric generators can be located at any convenient place and the power distributed over wires to the various machines located around the shops. This gives a flexibility of distribution and control that cannot be secured easily and cheaply by any other way. When electric drive was first installed the machines were driven either individually or collectively. The usual practice has been to drive larger machines, such as big lathes, planers and boring mills by independent motors and to operate smaller tools in groups from line shafting. The greatly improved design of modern motors eliminates the group drive which was necessitated by the fact that earlier types of motors were large and unwieldy and not suitable for mounting on headstocks of lathes or for direct connection to other machines. Modern motors, built specially for driving shop machinery, are compact, with a wide range of sizes and requisite speed variations when desirable, so that individual drive can be used throughout. The present line of direct-current motors are equipped with commutating or interpoles, and by means of field rheostats any speed variation up to and including four to one is wholly practicable.

Constant speed motors, however, fulfill the requirements largely and have been well developed for industrial service. Probably 75 per cent. of the electric power used for shop operation is required for constant speed machines and electric lights. In the railway-shop power house the most satisfactory arrangement for generating current consists of alternating current generators coupled either to turbines or reciprocating current motors, namely, the induction type with squirrel-cage winding, is essentially a constant speed machine, entailing little care and minimum maintenance charges. Motors of this type are well adapted for the operation of machine tools for which constant speed suffices. If direct current is needed, so as to have a wide variation in speed of the motor drive, the alternating current can be changed over to direct current by means of a motor-generator set. Alternating current motors, however, have been applied very successfully for variable speed work to cranes, transfer tables, turntables, hoists, etc.

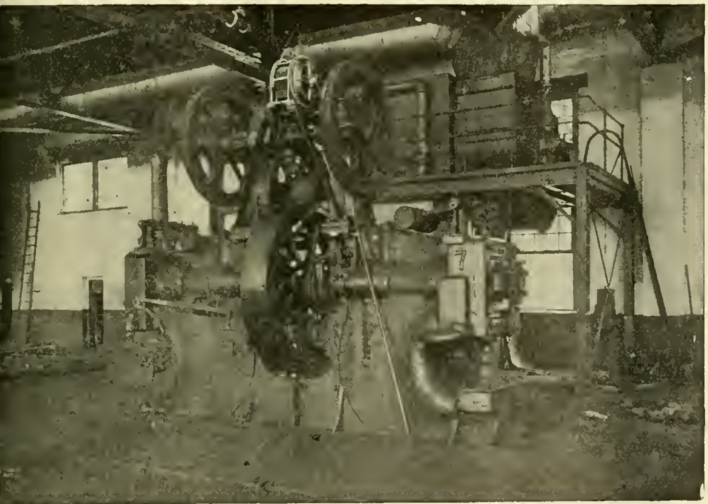


ELECTRICAL DRIVE FOR RAILROAD REPAIR SHOPS.

The line of both direct current and

alternating current motors ranging in h. p. from one-half to several hundred, manufactured by the General Electric Co., provides for every application of electric power to machines and tools in railroad shops. All of these motors are of rugged and symmetrical construction with low centers of gravity, and are adapted especially for the severest duty in driving machine tools. The commutating pole design affords superior overload and operative characteristics.

For the control of motors when operating machinery, where frequent stopping and starting is essential, drum type controllers have been found to give much better satisfaction than other types. The General Electric Co. offers a complete line of these controllers for both constant and adjustable speed motors when applied to individual drive. Usually drum controllers are arranged for reverse operation, especially when used for machine tools. The illustrations show the application of the electric motor in a railway shop.



MOTOR DRIVE FOR RAILROAD REPAIR SHOPS.

Electric Batteries.

Electric currents are direct or continuous and alternating. Continuous or direct currents are produced by voltaic cells, batteries and dynamos. Alternating currents are produced by a special generator. We will describe the various voltaic cells and then take up the storage batteries of the more modern types.

The discovery of electric currents originated with Galvani, a physician of Bologna, who, in 1786, found that an electric current existed when two dissimilar metals, iron and copper, were brought together. It remained for Volta, a professor, however, to convince people that this was so. He took discs of zinc and copper and constructed what is known as the Voltaic Pile and which was the first electric cell. The discs were piled one on top of the other with a zinc and copper in contact and a piece of flannel moistened with brine between each pair of metal discs. A slight shock would be felt if the top and bottom of this pile were touched simultaneously.

A simple voltaic cell consists of a strip of copper and a strip of zinc placed in a glass jar containing water with a little sulphuric acid. This cell will supply a continuous flow of electricity through a wire connected to the two strips of metal. The zinc is the metal that is consumed and which drives the current to the copper and so on through the wire back to the zinc. The copper merely acts as a receiver to pick up the current. Both metals are trying to set up the electric current, but the flow does not take place until the metals are joined together by the wire. It is not possible to obtain absolutely pure zinc in a commercial state so that the zinc would be gradually eaten by the acid even if the wire did not connect the zinc plate to the copper. To prevent this the zinc can be amalgamated or coated with mercury. This mercury does not effect the operation of the cell as an electric current producer.

While the cell is in operation hydrogen gas is liberated at the surface of the copper and will, after a few minutes, cut down the power of the cell. The hydrogen gas will collect as bubbles and cling to the copper plate, decreasing the effective area. This is known as Polarization and occurs on practically all of dry cells on the market today. If the cell is allowed to stand for a few minutes full power can be obtained again, as the gas will disappear from the copper plate. It is possible, by employing double cells to eliminate this polarization. This is done in the *Daniell's Cell*, which we will describe and which is probably known to many of our readers.

The cell has an inner porous cell of unglazed porous ware in which is placed the rod of amalgamated zinc. The liquid in the porous cell is dilute sulphuric acid or dilute sulphate of zinc. The outer vessel is usually of copper and serves the double purpose of a vessel and also as the other metal. This outer vessel contains a saturated solution of copper sulphate ("blue vitriol"). The porous cell is placed in the blue vitriol solution. When the circuit is closed the zinc dissolves, giving up hydrogen. This hydrogen does not appear as bubbles but passes through the porous cell and is replaced by copper, the copper depositing on the outer copper vessel. In order to supply the necessary copper, crystals of "blue vitriol" are kept in the solution so as to dissolve and replace the pure copper which is taken from the solution and deposited.

A more modern form of this Daniell's Cell consists of a glass jar and no inner porous cell. The two liquids are placed in the same glass jar, and due to the different densities they will separate, the "blue vitriol" solution settling to the bottom. A copper plate of "crowfoot" shape rests on the bottom and a zinc plate is suspended in the upper solution. This type is used with telegraphs, etc. It is known as a closed circuit type, for this cell can be used continuously without loss of power.

Another common cell, used for working electric bells and telephones is known as the *Leclauche's Cell.* One terminal is zinc, the other carbon, both placed in a glass jar partially filled with a solution of salamoniac. The carbon is treated with a black powder to illuminate the polarization. It is adapted for open circuits, that is to say, for those cases in which the current is only required for a few minutes at a time, and the circuit usually left over.

Dry cells are very common and reliable. The space inside of the cell is filled up with a spongy mass, or even with plaster of Paris, in the pores of which the salamoniac solution remains. Primary batteries, or cells, are for open or closed circuits. Open circuit batteries are used where electric current is required in small quantities and very intermittently, as for ringing bells, lighting gas, etc. Closed-circuit batteries are used where a small but steady current is required for long periods of time, as in telegraphing, in operating fire alarms, railway signals, etc. For open-circuit work the Leclauche cell is much used; for closed-circuit work the Daniell cell is popular.

Air Brake Department

Empty and Load Brake Operating Valves.

In accord with a statement made in last month's issue we are presenting diagrammatic views of the operating valves of the Westinghouse "Empty and Load" freight car brake equipment in several different positions, to the intent that the flow of compressed air incidental to the operation of the valve mechanism may be conveniently traced.

Those views show only the ports and passages in use during the time the valves are in the particular position designated and this will avoid confusion and the possibility of mistakes that might occur if all of the various ports, passages and cavities were shown in each individual view.

As the past issue contains quite a complete general description of the construction and operation of the brake and states where compartments of the reservoir are charged, and when and for what purpose the various valves are thrown into operation, it should not be necessary to dwell upon this particular phase of the subject any further than an occasional reference to the several views that have already appeared and to follow the course of the compressed air through the valves when the indicated positions are assumed.

As previously stated, when the change over valve is in "empty car" position, the triple valve performs the functions of any ordinary K triple valve as but one brake cylinder and one reservoir are in use therefore retarded release, full service and emergency positions of the triple valve are shown with change over valve in load position, but for comparison the slight difference between full service and quick service positions is shown with the change over valve in empty position while the triple valve is in quick service.

Compressed air from the brake pipe enters the triple valve and forces the triple valve piston and slide valve to either normal or retarded release position, depending upon the differential in brake pipe and auxiliary reservoir pressure, the difference in the positions is that in retarded release position the exhaust of brake cylinder pressure is restricted and the auxiliary reservoir is charged at a slower rate than when the triple valve is in normal release position, but the retarded release and uniform recharge features are now too well known to require any further comment at the present time.

The difference between retarded release position load, and retarded release position empty, is that in load position two brake cylinder exhaust ports are used so that the additional brake cylinder vol-

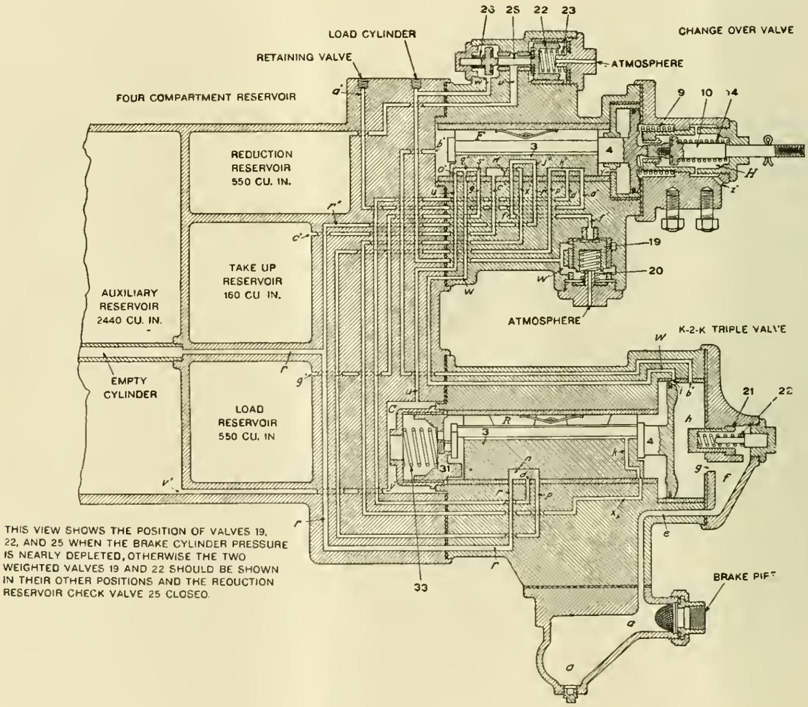


FIG. 1. RETARDED RELEASE. CHANGE OVER VALVE IN LOAD POSITION.

ume will be exhausted in the same length of time, and it should be noted that in all cases additional ports are provided for use in load position, consequently the charge, recharge and exhaust of the slightly increased volume of air pressure necessary to operate the load cylinder will be uniform as to time throughout the entire train.

Fig. 1 shows the change over valve in load position and the triple valve in retarded release position. The operating lever is moved to exhaust the pressure back of the cut-out piston and the pressure always present in chamber F holds the piston and slide valve in this position until the lever is again moved or, if not piston to release position the auxiliary reservoir is charged through the usual feed groove, while brake pipe pressure is free to flow through port b' to the chamber F holding the cut-out slide valve to its seat. The load reservoir is charged from chamber C, port u through a cavity q' in the cut-out slide valve and port g' and to make the charging time uniform, brake pipe air also enters, or rather the charging is augmented by the addition of port W. The take-up reservoir is charged through port X, cavity n' in the cut-out slide valve and port c'. This flow of air continues until the reservoirs mentioned are charged equal to brake pipe pressure. At this time, the retaining valve the load cylinder exhaust port closed, then load cylinder and reduction reservoir pressure would flow from port w' through port f' to the cut-out slide valve, then through j' and r' to cavity n of the triple slide valve, then again to the cut-out slide valve through ports p and p', also d and d' through cavity k' and finally port a' to the retaining valve and atmosphere.

As "empty" brake cylinder pressure also flows through port r to cavity n of the triple slide valve, two exhaust outlets or passages are provided between cavity n and cavity k' of the cut-out slide valve.

When the equipment is charged and a brake application is desired, brake pipe

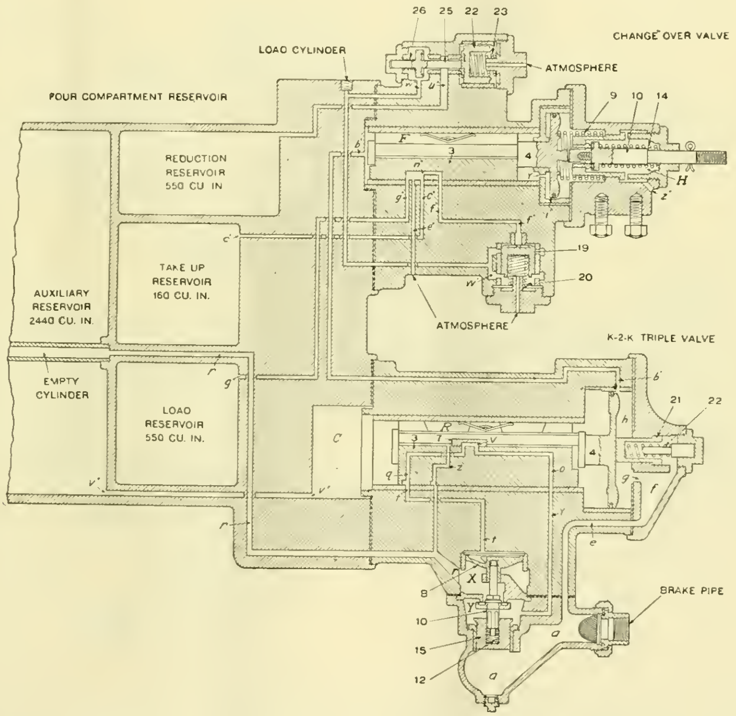


FIG 2. QUICK SERVICE. CHANGE OVER VALVE IN EMPTY POSITION.

locked in position, until the pressures are depleted.

The triple valve is shown in retarded release position which is only possible at the head end of the long train and when the auxiliary reservoir is charged to within about 3 pounds of the brake pipe pressure spring 33 returns it to normal release and charging position.

The flow of air in charging is the same in both retarded and full release positions, and referring to Fig. 1, brake pipe pressure having forced the triple valve being turned down, the empty brake cylinder is open to the atmosphere through port r, cavity n in the triple slide-valve, port p thence to cavity k' in the cut-out slide valve and through port a' to the retaining valve and atmosphere, while the load cylinder and reduction reservoir are open to the atmosphere through port u' valve 25 and port w' past valve 19. If, however, the brake cylinders contained considerable air pressure at the time the triple valve was moved to release position, spring 20 would be compressed and pressure is reduced in the usual manner and the pressure falling faster in the brake pipe than the stored pressure can flow backward through the feed grooves causes a difference in pressure on the triple piston and the valves are moved toward the weakening pressure until the piston strikes the graduating spring abutment.

Whether the triple valve is moved to quick service or full service position depends upon the rate of brake pipe reduction.

When the brake pipe reduction is comparatively slow the triple valve stops in quick service position and the flow of air from the auxiliary reservoir to the brake cylinder is slightly restricted and brake pipe pressure enters the brake cylinder from cavity Y in the triple valve through ports y, o, cavity V in the graduating valve and ports q, t and r to the brake cylinder. In full service position the service port is opened wide and the brake pipe flow to the cylinder is cut-off, thus the serial application is hastened when it is desirable and cut out when unnecessary or undesirable and as the difference in positions is merely a fraction of an inch in movement of the triple slide valve, the change over valve is shown in "empty" position for a comparison, while the triple valve is shown in quick service but in full service the change over valve is again shown in "load" position and as we are considering the load position, the brake pipe reduction causes auxiliary and brake pipe pressure to flow into the brake cylinder as explained and in addition "take up" reservoir pressure is free to flow to the brake cylinder through port c', cavity n' of the cut-out slide valve, then through ports x', x, cavity m in the triple slide valve, then through port c to the under side of check valve 37, then through ports r'' to the brake cylinder. Non-return check valve 37 prevents a back flow of brake cylinder pressure to the take-up reservoir.

The load reservoir is at this time an extension of the auxiliary, it being connected through ports g', s', cavity q' in the cut-out slide valve, thence through ports u and w to the cavity C in which the triple slide valve operates.

Brake cylinder pressure is now free to flow through ports r', j' in the cut-out slide valve through port f' to valve 19, and when about 24 pounds pressure is obtained in the brake cylinder spring 20 will be overpowered and "empty" brake cylinder pressure enters the load cylinder through port w' and also the reduction reservoir through ports w' and u'.

In the previous description of this brake it was pointed out that pressure entering the brake cylinder from the auxiliary reservoir, brake pipe, load reservoir and take-up reservoir resulted in about 24 pounds cylinder pressure for a 7-lb. brake pipe reduction as against 7 or 8 pounds cylinder pressure when the equipment is in empty position or if the ordinary brake is under consideration, and in this manner the per cent. of braking power for the loaded car is provided by increased cylinder pressure up to the time the second cylinder is necessary, then as the second or load cylinder comes into action with its extremely short piston travel a doubling of piston area necessitates a drop or halving of cylinder pressure, thus by the momentary addition of the reduction reservoir and instantaneous and unwarranted increase in braking effect is prevented and as soon as the pressure in the reduction reservoir reaches about 12 pounds spring 23 will be overpowered and valve 25 will cut off the reduction reservoir and the subsequent reductions will continue to develop the proper per cent. of braking power per pound of brake pipe reduction up to the point of equalization in pressure. Upon reflection it will become apparent that with this arrangement practically uniform cylinder pressure and uniform retarding effect is obtained throughout the full application.

In the event of a bursted hose, broken brake pipe or an emergency application the sudden reduction in brake pipe pressure causes the triple valve piston to

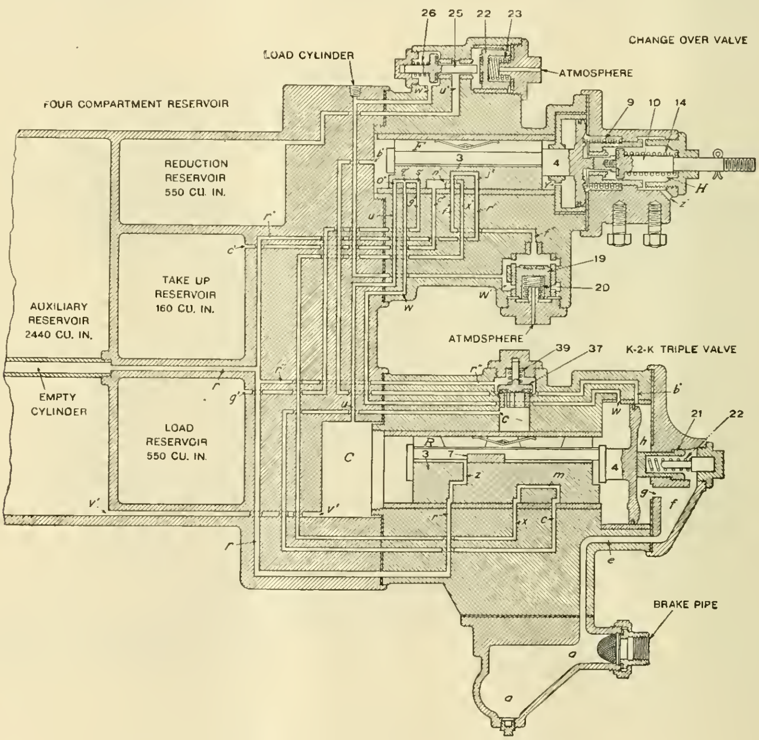


FIG. 3. FULL SERVICE. CHANGE OVER VALVE—LOAD.

travel its full stroke, compressing the graduating spring. Brake pipe pressure then enters the brake cylinder in the usual manner past the emergency valve, and the object of this action is also too well known to our readers to require any comment. The relation of the load and take-up reservoirs is the same as in full service position. At such a time the flow of air to the reduction reservoir is so rapid that valve 25 closes before more than 5 pounds can accumulate in this reservoir, which is, of course, a slight gain in brake cylinder pressure in addition to that gained from the inrush from the brake pipe.

5-64 of an inch, but due to a difference in fitting the equalizing piston and ring the rate of reduction in equalizing reservoir pressure has in some instances exceeded that intended. In former types of brake valves a 5-64 opening was necessary to reduce the pressure in the 10 x 12 equalizing reservoir from 110 lbs. to 90 lbs., in from 6 to 7 seconds, which is considered the proper rate. In some instances of exceptionally well fitted piston rings it was found that the rate of reduction tended to decrease the time required, and for high-speed brake service a 10 x 14½ reservoir was substituted for the 10 x 12, which tended to lengthen the neatly as that of the H6 valve, a 5-64 exhaust port proved to be too large, as it would reduce equalizing reservoir pressure at too rapid a rate when no air could get past the ring from the brake pipe to partially compensate for that being discharged through the preliminary exhaust port.

The result was that the time for making 20 lbs. reduction from 110 lbs. pressure came to be from 4 to 5 seconds with the 10 x 14½ reservoir, instead of from 6 to 7 seconds, the desirable rate that insures satisfactory brake operation. For these reasons it was found advisable to reduce the size of the preliminary ex-

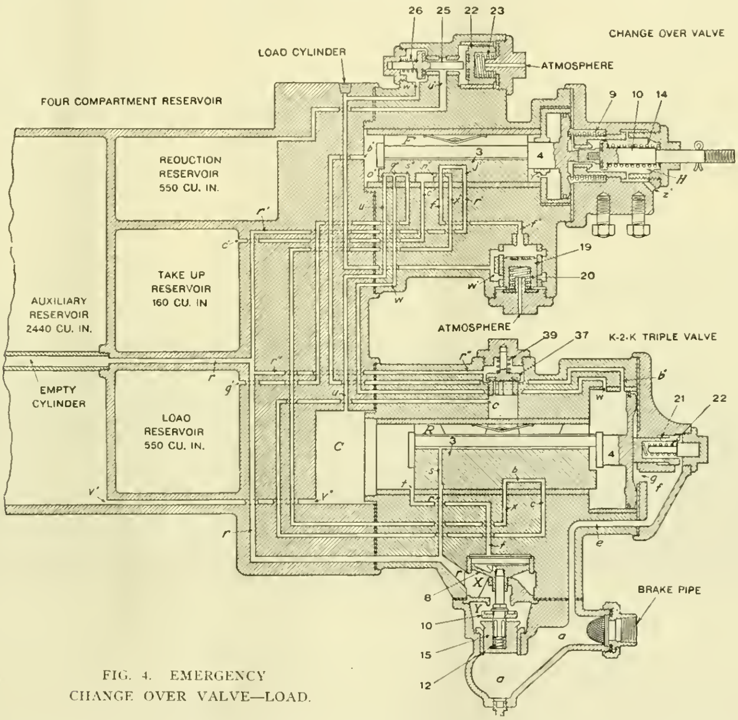


FIG. 4. EMERGENCY CHANGE OVER VALVE—LOAD.

A glance at Fig. 4 shows that in this position the chamber F in which the cut-out slide valve operates is supplied from the auxiliary reservoir through the same port, *b'*, therefore the loss of brake pipe pressure cannot permit the cut-out slide valve to become unseated.

After an application of any kind the release is accomplished either by "bleeding off" the brake or restoring the brake pipe pressure and when the triple valve moves to release position, the exhaust of cylinder pressure and recharge of reservoir occurs.

Brake Valve Exhaust Port.

The present size of opening through the bushing in the preliminary exhaust port of the H6 brake valve is 1-16 of an inch. The size of the port was originally time of reduction and keep the time of the 20-lb. reduction to 6 and 7 seconds, under former conditions of piston ring fitting.

The equalizing piston packing ring was at that time what is known as a "friction" ring, that is, it was not fitted to entirely prevent leakage as is a triple valve piston ring, but was fitted to give a certain stability to the movement of the equalizing piston.

This method of fitting the ring was abondoned some time ago and the ring is now fitted up as a packing ring for the purpose of preventing any leakage from the brake pipe into the equalizing reservoir when making a brake pipe reduction.

With a packing ring fitted in this manner and a piston fitting the bushing as haust port to 1-16 of an inch, which is as small a port as is practicable.

Thus the time of reduction with a perfectly tight ring is brought back to from 5½ to 6½ seconds, which is practically the same as the original design, and so increases the margin between the rate of service brake pipe reduction and that required to produce an emergency application back to what it should be.

So far as equipments now in service are concerned, it should be assumed that no change is necessary unless with the brake valve handle in service position the rate of equalizing reservoir reduction is faster than the standard mentioned, namely, 20 lbs. reduction from 110 lbs. pressure in from 5½ to 6½ seconds, using a 10 x 14½ reservoir.

Mikado Type of Locomotives for the Lackawanna

Fifteen Mikado locomotives have just been completed for the Delaware, Lackawanna & Western Railroad by the American Locomotive Company. These will be used in both fast and slow freight service between Buffalo and Elmira. With a maximum tractive power of 57,000 pounds, and the large boiler capacity which it was possible to provide with the Mikado type wheel arrangement, these new locomotives will make it possible to operate much heavier trains than heretofore with the same helper service as at present employed on the ruling grades.

In slow freight service they replace consolidation locomotives having 26 in. x 30 in. cylinders and a theoretical maximum tractive power of 51,400 pounds. In fast freight service, they replace mogul locomotives having cylinders 20½ ins. x 26 ins., and a maximum tractive power of 29,480 pounds.

The Mikados have the same cylinder stroke as the consolidations, but 63 in instead of 57 in. drivers. Thus, with 10 per cent. greater maximum tractive power than the consolidations, they develop a still greater relative power at speeds of 15 or 20 miles per hour. Compared with the moguls, these new engines have almost 100 per cent. greater capacity.

In detail construction the design here illustrated follows the builder's latest approved practice. It embodies practically all of the new features recently introduced by them, which have already been widely adopted, and also some more recently introduced.

Among the last are the long main driving boxes. The same arrangement was applied to the Pacific type locomotives built for the same road. It gives a length of journal from 50 to 60 per cent. greater than is obtained with the usual construction and a corresponding increase in the width of the shoe and wedge bearing. At the same time, the spring load is transferred equally to all portions of the driving box and the frames and spring rigging are retained in their normal transverse centers. Though but comparatively recently introduced, this design of driving box has met with ready approval because it offers the means of reducing the wear on the boxes and increasing mileage before removal of the bearings becomes necessary. A number of other roads have already specified the style of driving box for their new power. It has been adopted for, in all, 82 locomotives built or under construction by these builders.

These locomotives are also equipped with the builder's outside steam pipes, self-centering arrangement of valve stem guide for the Walschaerts valve gear, and the self-centering guide for the extended piston rod.

Aside from the interesting detail construction, the design is characterized by exceptionally large boiler capacity. The boiler is equipped with a superheater of the top-header double loop type providing 1,085 sq. ft. of superheating surface, the largest amount ever provided in a simple locomotive built by this company. At the same time, by the use of 21-ft, 2-in. tubes, a very large evaporating heating surface of 4,854 sq. ft. has been provided. The firebox is also equipped with the "Security" brick arch. The ash pan is of the six-hopper design similar to the style applied to the Mountain and Mikado type locomotives constructed by the same builders for the Chesapeake & Ohio Railway.

The following are the principal dimensions of this type of locomotive:

Cylinder—Type, simple, piston valve; diameter, 28 ins.; stroke, 30 ins.

Track gauge, 4 ft. 8½ ins.; tractive power, 57,000 lbs.

Wheel base—Driving, 17 ft 0 ins.; rigid, 17 ft. 0 ins.; total, 35 ft. 5 ins.; wheel base total, engine and tender, 67 ft. 7 ins.

Weight, in working order, 312,000 lbs.; on drivers, 236,500 lbs.; engine and tender, 471,700 lbs.

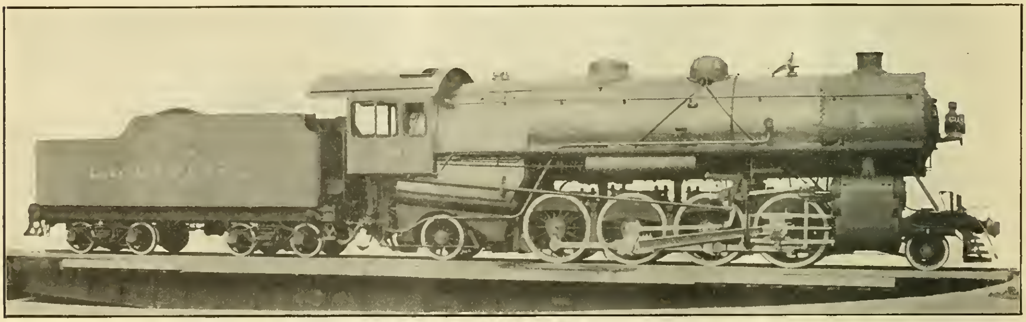
Heating surface—Tubes, 5⅜ ins., 1,265 sq. ft.; 2 ins., 3,327.8 sq. ft.; firebox, 234 sq. ft.; arch tubes, 27.3 sq. ft.; total, 4,854.1 sq. ft.; s. h., 1,085 sq. ft.

Grate area, 63.1 sq. ft.

Axles—Driving journals, main, 11 x 21 ins.; others, 10½ x 13 ins.; engine truck journals, diameter 6 ins., length 12 ins.; trailing truck journals, diameter 9 ins., length 14 ins.; tender truck journals, diameter 6 ins., length 11 ins.

Boiler—Type, straight top, O. D. first ring, 86⅛ ins.; working pressure, 180 lbs.; fuel, bituminous coal.

Firebox—Type, wide; length, 108 ins.; width, 84¼ ins.; thickness of crown, ⅜ in.; tube, ½ in.; sides, ⅜ in.; back, ⅜ in.; water space, front, 6 ins.; sides, 5 ins.; back, 5 ins.



MIKADO TYPE OF LOCOMOTIVES FOR THE DELAWARE, LACKAWANNA & WESTERN RAILROAD.
H. C. Manchester, Superintendent of Motive Power. American Locomotive Company, Builders.

Crown staying, radial.

Tubes—Material, charcoal iron; No. 304; diameter, 2 ins.; length, 21 ft. 0 ins.; gauge, 11 B. W. G.

Piston—Rod diameter, 4½ ins.; piston packing, gun iron rings.

Smoke stack—Diameter, 18 ins.; top above rail, 15 ft. 2 9/16 ins.

Valves—Type, piston, 16 ins.; travel, 7 ins.; steam lap, 1 3/16 ins.; ex. lap, C. L. Line & Line.

Setting, ⅛ in. lead.

Wheels—Driving diameter outside tire, 63 ins.; centers diameter, 56 ins.

Tank—Style, water bottom; capacity, 8,000 gallons; fuel, 14 tons.

Engine truck wheels—Diameter, 33 ins.; trailing, 42 ins.; tender, 33 ins.

43 Flues, 5⅜ ins. diameter; No. 9 B. W. G.

Schmidt fire-tube top header-type A superheater applied.

Modern Car Shop Equipment.

Modern equipment in any kind of shop or factory is as essential to its operation as capital. And the plant without capital behind it cannot be expected to exist long. The shop without modern equipment is doomed to fail, because it cannot—it is impossible to—turn out work of the same character, in as short a time, at as low a cost as the plant equipped with modern tools.

And no kind of shop should have a more modern equipment than the railway car shop. There, where big heavy timbers for sills, arches and liners are necessarily used, and mortising, boring, tenoning and gaining forms a big portion of the work, the time and labor expense of handling them through these several operations, one at a time, is so pronounced that the elimination of this excessive manufacturing cost is an absolute necessity. But, without a modern equipment, there is no relief from this state of affairs.

The accompanying illustration shows how the problem of working these timbers at a minimum expenditure of time and labor has been solved by J. A. Fay & Egan Co., Cincinnati, Ohio. It is a Fay-Egan "Lightning" Installation in the shops of a large railway system in the South. It has been taken advantage of by many large railway companies. It consists of a combination of their High Duty No. 150 Automatic Car Gainer, Extra Heavy No. 214 Vertical Hollow Chisel Mortiser and Extra Heavy No. 163 Vertical Car Borer, with a 40-foot traveling carriage, working as a unit. The timbers are run through a Fay-Egan No. 171 Sizer, which is lined up with the carriage of the combination machine, and onto which it passes. The timber once on the carriage does not have to be handled again until it is ready for the erectors. The timber is carried automatically to each machine in succession, completing the necessary operations at each before passing on to the next, the borer putting in the straight and angle bolt holes, the mortiser with its large capacity rapidly cutting out and cleaning the mortises as well as making double tenons when desired, and the gainer cutting the gains and tenons. Levers and hand wheels in front of each machine give operator full control of the movement of carriage from any point.

In addition to the time and labor-saving features of this installation, the economy in floor space should also be noted. This is particularly apparent when the equipment is electrically driven as shown in the picture, to which type of drive it is especially well adapted. Each of the machines shown is a self-contained modern high duty car shop tool, a separate unit in itself, which may be combined with either or both of the others to suit the individual requirements.

It is gratifying to observe not only in all of the new shops, but in many of the older shops the electric motor drive is coming rapidly into favor and meeting the warm approval of the skilled workman.

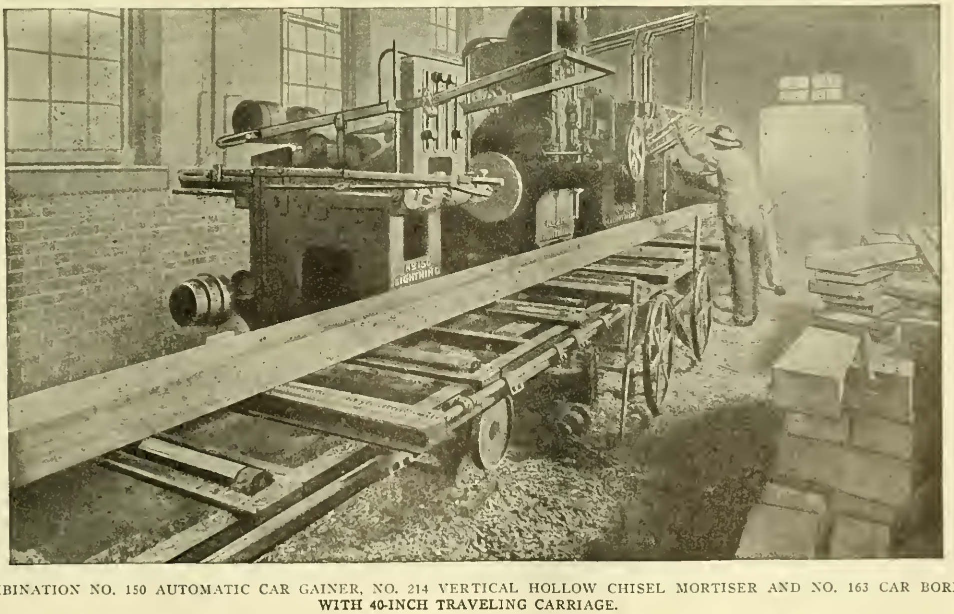
Engineer Blamed.

REPORT OF INTERSTATE COMMERCE COMMISSION.

In the early part of last month the officials of the Interstate Commerce Commission report that failure of William Schroeder, the engineer, to observe and be governed by block signals was the cause, officially assigned today, for the collision of the Delaware, Lackawanna & Western Railroad at East Corning, N. Y., July 4, which resulted in the death of thirty-nine passengers and the injury of eighty-six other passengers and two employees.

This conclusion was reached by the chief inspector, H. W. Belnap, in his report to the Interstate Commerce Commission. The inspector says a contributing cause of the accident was the failure of E. G. Lane, the flagman, to use torpedoes. The automatic block signals operated properly and would have prevented the collision if they had been obeyed. In conclusion, Mr. Belnap reported briefly as follows:

As a result of the investigation of this accident, the conclusion is confirmed that the use of steel cars would materially reduce the number of fatalities in accidents of this character. It is also believed that a greater degree of safety would be provided if flagging rules were more explicit and the use of torpedoes were required; and, if automatic block signals were properly overlapped and the speed of fast trains were reduced in foggy or stormy weather, unless automatic train control devices were installed.



COMBINATION NO. 150 AUTOMATIC CAR GAINER, NO. 214 VERTICAL HOLLOW CHISEL MORTISER AND NO. 163 CAR BORER WITH 40-INCH TRAVELING CARRIAGE.

Items of Personal Interest

Mr. C. C. Elmes has been appointed master mechanic of the Southern Pacific shops at Houston, Tex.

Mr. W. M. Thornberry has been appointed general foreman of the Illinois Central shops at Clinton, Ill.

Mr. J. R. Sexton has been appointed mechanical superintendent of the Santa Fe, with office at La Junta, Colo.

Mr. W. L. Davis has been appointed roundhouse foreman on the Santa Fe, at Chanute, Kan., in place of Mr. R. W. Eddleman, resigned.

Mr. John W. Branton has been appointed master mechanic of the Centralia district of the Illinois Central with office at Centralia, Ill.

Mr. W. H. McDonald has been appointed general foreman of the locomotive repair shops on the Florida East Coast at St. Augustine, Fla.

Mr. F. L. Carsen has been appointed master mechanic of the San Antonio & Aransas Pass at Yoakum, Tex., in place of Mr. J. F. Sullivan, resigned.

Mr. C. E. Perry has been appointed general foreman, and Mr. E. W. Tucker has been appointed roundhouse foreman of the Santa Fe at Needles, Cal.

Mr. A. Spaulding has been appointed road foreman of engines on the Chicago and North Western, West Iowa division, with headquarters at Boone, Iowa.

Mr. C. Bowersox, formerly general foreman of the Clover Leaf, has been appointed general foreman of the Toledo and Ohio Central, at Bucyrus, Ohio.

Mr. E. F. Fay, formerly master machanic of the Union Pacific at Cheyenne, Wyo., has been appointed master mechanic of the Illinois Central at Waterloo, Ia.

Mr. C. E. Croom has been appointed general foreman of the Atlanta, Birmingham & Atlantic, with office at Manchester, Ala. He succeeds Mr. J. F. Freeman.

Mr. L. A. Stoll, general foreman of the Chicago, Burlington & Quincy at Aurora, Ill., has been appointed assistant superintendent of the Aurora shops in charge of the locomotive department.

Mr. H. G. Burnham, chemist and engineer of tests of the Buffalo, Rochester & Pittsburgh, at Du Bois, Pa., has been appointed engineer of tests of the Northern Pacific, with headquarters at St. Paul, Minn.

Mr. J. T. Benedict, formerly vice-president of the Boss Nut Company, has been elected president to succeed Mr. B. M. Osbeen, who has resigned to accept the presidency of the Auto Refrigeration Company, Chicago, Ill.

T. H. Goodnow, general superintendent of the Armour Car Lines at Chicago, has been appointed assistant superintendent of the car department of the Chicago & North Western, with office at Chicago, succeeding C. H. Osborn, resigned to engage in other business.

E. G. Chenoweth, mechanical engineer of the Erie Railroad at Meadville, Pa., has been appointed assistant superintendent of the car department of the Chicago Terminal division of the Rock Island Lines, with office at the 124th street shops, Blue Island, Ill.

Mr. Frank E. Smith, a well-known veteran engineer of the Lake Shore, has been appointed special instructor to passenger engineers for the purpose of improving the general efficiency of the engineers. His jurisdiction extends from Elkart, Ind., to Chicago, Ill.

ROBERT A. PYNE.

Prof. John E. Sweet will attain his eightieth birthday this year, and it is planned to tender him a reception about the time of the annual meeting of the American Society of Mechanical Engineers, of which he was one of the founders and is an honorary member and past president.

Mr. R. H. Wallace has been appointed supervisor of locomotive operation on the Baltimore and Ohio Southwestern with office at Cincinnati, Ohio, and Mr. J. S. Lemley has been appointed to a similar position on the Illinois division of the same road, also with office at Cincinnati, Ohio.

Mr. W. P. Scott, vice-president and general manager of the Union Pacific Railroad, has been elected president of the Southern Pacific Company lines in Louisiana and Texas at a recent meeting of the directors. Mr. Scott will succeed Mr. Thornwell Fay, whose resignation, effective September 1, has been accepted.

Mr. H. F. Wardell, at one time superintendent of power and equipment on the Chicago & Western Indiana, has resigned as assistant manager of the Central Locomotive & Car Works, Chicago, to engage in the railway equipment business on his own account, and has opened an office at 302 Railway Exchange building, Chicago.

Mr. W. W. Neale has been appointed master mechanic on the Baltimore and Ohio at Keyser, W. Va., in place of Mr. J. W. Rupert, transferred, and Mr. F. T. Philipins has been appointed general foreman, also at Keyser, in place of Mr. J. P. Hines, who has been transferred to Brunswick, Ind., as general foreman in place of Mr. Neale, promoted.

Mr. C. A. Gill, master mechanic of the Cincinnati, Hamilton and Dayton at Ivorydale, Ohio, has his jurisdiction extended over the Toledo and Delphos divisions, including Fort Hayne branch and Dayton terminal. Other changes include the appointment of Mr. M. J. Ryan as road foreman of engines of the Indianapolis division, and Mr. M. P. Hoban as road foreman of engines on the Toledo.

Mr. Robt. A. Pyne, recently appointed superintendent of shops at Winnipeg, Can., entered the service of the Canadian Pacific at Winnipeg as machinist apprentice July, 1887. Appointed gang foreman in repair shop December, 1897. Made shop foreman Winnipeg roundhouse July, 1899. Promoted to position of erecting shop foreman in charge of repairs March, 1901. Promoted to position of general foreman of Calgary shops July, 1902. Made locomotive foreman at Brandon, Manitoba, January, 1903. Promoted to position of district master mechanic, Moosejaw, Saskatchewan, October, 1906. Transferred to Nelson, B. C., as district master mechanic April, 1909. Promoted to position of master mechanic in charge of Western Division, with headquarters at Calgary, Alta., March, 1910. Promoted to position of superintendent of shops, Winnipeg, January, 1912. All his service and experience has been with the Canadian Pacific Railway Company.

G. E. Buckley, for six years assistant engineer of the Southern Railway at Charlotte, N. C., has been appointed engineer maintenance of way of the Western district of that road, with office at St. Louis, Mo., succeeding Edward Gray, resigned to engage in other business.

Joseph Ury Crawford, consulting engineer of the Pennsylvania and one of the most prominent officers in its service, having reached the age of seventy years yesterday, will retire from active work on September 1, according to the pension rules of the road. Aside from an enviable war record, Colonel Crawford attained fame as an engineer both at home and abroad.

He entered the service of the Pennsylvania as senior assistant engineer of the Alexandria & Fredericksburg during 1871 and 1872. He was principal assistant engineer and afterwards engineer, of the California division of the Texas & Pacific. He was consulting engineer to the United States Government in 1898-99 on transportation in Cuba. In 1910, Mr. Crawford was decorated by the Emperor of Japan for faithful service as consulting engineer and inspector of the Imperial Government railways. On January 5, 1911, Mr. Crawford was appointed consulting engineer of the Pennsylvania.

OBITUARY.

Joseph L. C. Davis.

Mr. Joseph Le Conte Davis, Engineer in Charge of Design of Direct-Current Railway Type Motors embracing mining and vehicle truck motors, graduated from the University of South Carolina in 1897 with the degree of Electrical Engineer.

He was professor of physics at Bingham Academy High School in North Carolina from 1897 to 1900. He entered the employ of the General Electric Company at Schenectady, N. Y., and was engaged in engineering for this company from 1900 to 1904. Mr. Davis was also at one time in charge of the development of the National Electric Signalling Company which embraces the Fessendon Wireless System. Since 1904 he was employed by the Westinghouse Electric & Manufacturing Company as a designing engineer in the Electric Railway Department.

Mr. Davis was regarded as one of the brightest and most promising of the younger electrical engineers of the present day. His work in connection with the design of the direct-current motors used on the Pennsylvania Terminal Electrification, and many other large installations had brought him into great prominence before the electrical men of the country and his loss will be a great one to the engineering profession at large. He died last month and is much regretted by all who knew him.

Traveling Engineers' Convention

The twentieth annual convention of the Traveling Engineers' Association met in the Hotel Sherman on August 27, and was in session four days. As RAILWAY AND LOCOMOTIVE ENGINEERING went to press before that convention was finished, we are unable to publish the proceedings in this issue, but we will present a full report next month. Meanwhile we submit to our readers the following:

President Hayes opening address:

PRELIMINARY.

As the chief executive of the Traveling Engineers' Association, I take pleasure in extending to the members, their wives, sweethearts, and friends, a cordial greeting and a most hearty welcome to this, the Twentieth Annual Convention. I trust you will have a most enjoyable time during the convention period and at its close be returned safely to your respective homes.

Through their good will and the pride taken in their work, a committee of the Railway Supply Men's Association, working in conjunction with the executive committee of the Traveling Engineers' Association, has prepared quite an elaborate programme for your entertainment, which will delight the eye and ear of all, especially of the ladies, for whom special provision has been made. My advice to all of you who desire to take advantage of the privileges outlined is to put yourselves in close touch with this committee so as to expedite their plans for your benefit, as by so doing you will materially assist the different committees in making all the entertainment features successful.

It is desired at this time to call your attention to the printed programme which, you will note, does not in any manner interfere with your attendance at the meetings, but simply provides sufficient recreation for all concerned.

Permit me at this time to express sincere appreciation of the large attendance at this meeting, which—indicative of the strong and growing character of the association—shows in a most forceful way that no mistake was made by the executive committee in again selecting "Chicago" as the place of meeting for the 1912 convention and thus affording as well as extending the privilege of attendance to a greater percentage of the members than would otherwise have been the case. It also secures to them the benefits to be derived from an interchange of opinion on the different topics of interest which will be brought before this convention.

HISTORY.

To those not acquainted with the history and origin of the Traveling Engineers' Association, I will state briefly that its organization was planned and executed by a few men who, under the leadership of our first and only secretary, assembled for that purpose at the Root Street engine house of the Lake Shore & Michigan Southern Railway, in the city of Chicago, Ill., in the year 1892 and launched a young and vigorous organization destined to cut a wide swath in improving the operation of locomotives on American railways. If numbers are the test of efficiency, then indeed has the Traveling Engineers' Association won its spurs. Starting in 1892 with only a small membership it has grown to such an extent that there are now nearly 900 members enrolled, the past year, alone, showing an increase of 88 new members or 11 per cent., which is surely a handsome growth in these strenuous times. These men who stand as our preceptors in the creation of this organization have shown clearly that they builded better and wiser than they knew, when they banded together in one common aim an organization that has grown to such stalwart proportions, "Realizing fully that nothing on this part of the footstool stands still," in fact, the stool itself does not—everything goes ahead—progresses or retrogresses. Therefore, the keynote of this new association was the consecration of these few men to this task as their chosen life work. It presents a spectacle that is good to look at in the retrospect. Here was born a young labor union of the right sort, banded together upon the right principles—courting success—fearless of failure—in fact, having no such words in their decalogue as "can't" or "give up," but having their motto "to improve" ever before them. They have grown and developed, having long since shed their swaddling clothes until now it can justly be said, that they take front rank as a mechanical association, which, working in conjunction with other technical and mechanical organizations, helps to solve for a common purpose the progressive mechanical problems of the day, so far as "Locomotive Operation" is concerned. Now of what, I pray you, does "Locomotive Operation" consist? Henderson's work on "Locomotive Operation" defines it as the "results accomplished by a locomotive in motion." In my opinion it means being able to quickly and efficiently handle the large modern locomotive, to have and to keep it under perfect control at all times and to secure maximum or minimum service at any time desired.

RESPONSIBILITIES AND DUTIES.

No greater problem confronts any local officer upon any division of tbe railroads in this country today, than that which rests upon your shoulders. The greatest operating problem of the times is yours, and that is to make locomotives haul

every ton of freight 1 mile, or a given 100 or 1,000 ton miles at the lowest possible cost for repairs, fuel, lubricating materials, tools and other supplies. Upon this factor the cost of performing every operation that enters into plans of any magnitude on any trunk line in this country is founded.

It will thus be seen that the chief factor in securing results in locomotive operation is the ability on the part of the supervising officer, in charge of this work, first to so train himself as to be able to impart such instruction to engineers and firemen in regard to this problem as will enable them to see clearly just how, where and when the savings in mind can be secured; secondly to follow up systematically all educational lines by practical demonstration, so as to keep engine crews fully alive to the subject in hand; thirdly, to stimulate their interest by periodical class meetings in which new phases of the subject may be discussed, in other words, to point the way in every conceivable shape in order that the operation of locomotives may be made not only economical but attractive; fourthly, to arouse on the part of the engineers and firemen friendly competition in regard to the result of their individual performance of which a proper detailed record should be kept.

THE LANGUAGE OF THE ENGINE.

By following out the above line of thought; and, lastly, to teach all engineers that there is a language which the locomotive speaks and which every engineer worthy of the name, readily understands, for every piece of apparatus about the locomotive has its voice of contentment or wail of protest, hence the ability to understand and appreciate that language fully, cuts a large figure. These principles properly worked out in the operation are the only positive way to improve.

SMOKE PREVENTION.

Keeping dilligently at it so that results will flow in a progressive and permanent way, remembering at this time one thing, which in itself is quite important, that is, that the different municipalities, both east and west of this great and growing city, are expending considerable time and money in developing anti-black smoke ordinances, it is more than ever important that greater care and skill be practiced in the operation of locomotives than has been the case in the past, so as to minimize the amount of black smoke made. As a guide to better the firing of locomotives, the skilful engineer and fireman can do much toward the prevention of black smoke; but the price of a clean stack is constant vigilance on their part in order to keep themselves free from complaint or from violation of the law. Therefore recommendation is now made that the question of proper elimination of black smoke be taken up by this convention, with a view to finding a solution to that vexing problem. With the agitation that is now going forward on the part of many States and municipalities throughout the country, the time is not far distant when black smoke will be a disturbing factor which will have to be met and mastered, principally, I may say, by effort put forth by members of this association, so that it will be of greater necessity in the future than it has been in the past to face this question squarely and make very material improvement in the amount of black smoke produced.

SUPERVISING AND INSTRUCTING.

The duties of a traveling engineer are manifold in character (supervising and instructing engineers and firemen to a considerable extent), for the reason that he represents the management and also in a marked degree the engineers and firemen under his charge. Thus, by standing between the company and the men he performs a most worthy and surely a most exacting service. To my mind the traveling engineer is the most valuable supervising officer below the rank of superintendent on a division; as upon him depends largely the successful as well as the economical operation of the locomotives under his supervision. These duties impose upon him important responsibilities, among which may be cited as the chief factor in reaching results, "education." He must ever keep a watchful eye upon all phases of the work performed by every engineer and fireman in his territory, to see that his plans do not miscarry, as, in order to be successful, locomotives must be efficiently operated so as to insure maximum tonnage hauled with a minimum amount of fuel, lubricating materials, tools and other supplies. He must furnish such detailed information to the shop as to the condition of locomotives, that proper repairs may be made upon arrival to avoid failures on the line. It is for him to insist upon the most earnest attention to every detail of their duty on the part of the engineers in charge, also to be sure than every engineer is fully equipped to locate all defects so as to be able correctly to report all work requiring shop attention upon arrival, to bear in mind the fact that any additional burden imposed upon the shop through incorrect reports adds his mite "without rhyme or reason" to the growing cost of maintenance. Of course mistakes will occur once in a while, but it should be the exception that proves the rule.

CHARACTERISTICS OF MEMBERS.

When it is taken into account that every member of this association is a self-educated man—practically speaking—who has to wrest whatever success may be secured in improved operation of locomotives by making a study of the best methods that may be employed and then also making a study of a sure method to best impart that information to others, so it may be reflected in the service performed, it can readily be seen that the task which each traveling engineer, road foreman or supervisor of locomotive operation, whose duty it is to supervise the work of 50 or more engine crews, has set before him is not by any means a sinecure, but one involving large responsibilities, requiring a high type of man with a keen knowledge of the situation, in order that he may measure up to the duties of the position. In fact, he must be after the fashion of the man Kipling had in mind when he penned his words on man, "Give me the man who can hold on when others let go; who pushes ahead when others turn back; who stiffens up when others weaken; who advances when others retreat; who knows no such word as 'can't' or 'give up,' and I will show you a man who will win in the end no matter what opposes him; no matter what obstacles confronts him." This, my friends, is a pen portrait true to life of the majority of the members of this association, and is high commendation but in a deserving vein.

THE ROAD TO SUCCESS.

The above might be paraphrased as follows, so as to have direct application: "Give me the man who is always on time, whose resources can always be depended upon; whose chief aim is not always manufacturing an excuse for a failure; who spends more time seeking a remedy for some trouble than hunting an excuse for not being able to do things, and I will show you a successful official or locomotive engineer, as the case may be, whose standing is pointed to with pride, and the result of whose work in locomotive operation is economy exemplified." He is always at the head of the list, and his record is such that it furnishes to others a splendid example for emulation that leads to the required results. If the railroads of this country had a full complement of this class of men, certainly they would have little difficulty in measuring up to the standard in fuel-saving set by Mr. Brandies, though, to look at it from a distance, $200,000,000 annually appears like a prodigious sum.

CHARACTER OF PAPERS.

The character of the papers to be considered by this convention are of an unusually high grade and should invite much lively discussion which will be beneficial in educational results to the members, as well as to the railways represented—noting them in their order:

No. 1. "The increased efficiency of locomotives and benefits to be derived from chemically treated water."—Fred McArdle, chairman.

No. 2. "Fuel economy. What relation do mechanical appliances, such as 'superheater,' 'mechanical stokers,' 'brick arches' and the handling of trains have on this subject?"—F. P. Roesch, chairman.

No. 3. "Handling of long 'passenger' and 'freight' trains with modern air brake equipment."—W. F. Walsh, chairman.

No. 4. "What sort of inspection of locomotives and work reports should be required of engineers upon arrival at terminals?"—H. F. Henson, chairman.

No. 5. "How can the traveling engineer get engineers and firemen interested in economical use of fuel and lubricating materials, maintain that interest, and the influence upon fuel economy and lubricating methods?"—Robert Collett, chairman.

No. 6. "Paper 'individual.' What are the advantages vs. disadvantages of *'lead'* on modern high class locomotives?" —J. Fred Jennings, chairman.

With papers of such a high character, each presenting in itself a subject sufficiently meaty to call for a four day discussion without exhausting the subject, every member is given full range for all his power in this convention, so that no one can afford to miss the discussion of the subjects quoted without reflecting upon the committees in charge. It is pretty safe to say they will be thoroughly thrashed out and much valuable detailed information secured that on this account will send this convention down in the history of the association as the "banner convention" both in attendance and results accomplished.

Special attention is directed to the various mechanical appliances now on exhibition in the Karpen building, in which all of the members will be more or less vitally interested. From what I can learn of the character of the exhibits, no one can afford to leave Chicago without paying them one or more visits, and making such inspection as may appeal to them for their own information.

THANKS TO THE SECRETARY.

To our genial and efficient secretary sufficient thanks cannot be given. He has ably taken up the bulk of the burden of preparing and arranging the details of this meeting, of assisting the committees of arrangement, of both the Railway Supply Men's Association and the Traveling Engineers' Association to prepare for your entertainment and welfare upon this gala occasion. His position is so unique that it renders him indispensable, so please be assured, Mr. Secretary, that such service is duly and truly appreciated by the president and officers and by the members, all of whom are working to promote the principal aims and objects of the Traveling Engineers' Association in the fullest measure. I therefore wish to render unto "Cæsar the things that are Cæsar's" and take advantage of this opportunity to publicly thank you in behalf of and for all members of the Traveling Engineers' Association for the splendid record you have made as the "power behind the throne" of this now full grown organization. Permit me also to include in this public testimonial all other associate officers and members of the executive committees of the Traveling Engineers' Association as well as the officers and members of the Railway Supply Men's Association, who have and will continue to labor hard and earnestly to make your stay in Chicago both interesting and agreeable.

Introduction to Secretary's Report.

HISTORY OF ASSOCIATION.

At the meeting ten years ago your secretary related a little of the past history of this association. Apologizing for becoming reminiscent, as the slogan of this association, "To Improve the Locomotive Engine Service of American Railroads," does not stand for looking backward, however, it might be interesting to a large number of our members, present today, to hear a little of the past history of their organization.

A short time after the adjournment of the Master Mechanics' and Master Car Builders' Convention in 1892, a road foreman of engines, of one of the prominent lines running into Chicago, listened to a conversation between a representative of the Westinghouse Air Brake Company and his master mechanic relative to the good work that had been done at the convention and of how much benefit it was for a man in the railroad business to meet other men in the same business from all parts of the country and exchange views, experience, etc.

The conversation between the above mentioned gentlemen caused their listener to think that if the Master Mechanics' Convention was of such inestimable value to that class of men, why would not an association of traveling engineers be of even more importance, not only to the traveling engineers, but to the heads of the mechanical departments as well.

Acting on the thought at once, he started out to find traveling engineers enough to form an association, and strange as it may seem—as at the present time a member by referring to his latest annual report can find over six hundred names and addresses of traveling engineers—he consumed over ten months' time in getting the names of fourteen traveling engineers who were enthusiastically in favor of the idea, and they were representatives of the following roads: C. & N. W., C. & W. M., L. S. & M. S., P. & L. E., M. C., Erie, C. & G. T., Pennsylvania, N. Y. C. & St. L. Seven of the representatives have gone to that bourne from which no traveler returns, five have dropped out of the association for various reasons, and the remaining two are still honored members of this association.

After the fourteen traveling engineers who had been in favor of organizing had been heard from, a meeting was held at Chicago, Ill., November 14, 1892. The result of that meeting was the forming of a temporary organization, a chairman, secretary and treasurer being elected and committees appointed to draft a constitution and by-laws, etc.

During the meeting an invitation was received from Messrs. Sinclair and Hill, of RAILWAY AND LOCOMOTIVE ENGINEERING, to meet in their offices, at New York City, to perfect a permanent organization. Their kind invitation was accepted and the time for the meeting set for January 9, 1893.

The meeting was held at the appointed time and 53 members were enrolled. The first officers elected were as follows: President, C. B. Conger, C. & W. M.; first vice-president, J. W. Sheldon, P. R. R.; second vice-president, R. D. Davis, Illinois Central; treasurer, W. E. Miller, Vandalia; secretary, W. O. Thompson, L. S. & M. S. Members of the executive committee: A. S. Work, N. Y. C. & St. L.; J. D. Vantwood, M. L. S. & W.; W T. Hamer, E. T. V. & Ga.

Thus was the Traveling Engineers' Association, whose motto is "To Improve the Locomotive Engine Service of American Railroads"—and which motto has been rigidly adhered to during its twenty years of existence—started out in the world to do its share towards the wonderful progress that has been made in the past twenty years.

During the first few years of the association's existence its condition was rather precarious. At that time the newly created position of traveling engineer was not looked upon as a necessity by the managements of a good many railroads and this opinion was verified in the panic of 1894-5, when, approximately, 70 per cent. of our membership was set back to running engines, and had it not been for the hard, painstaking work of a number of our members, the almost immediate popularity of reports and researches of our committees, the loyalty of a few of the higher railway officials, the press and a few railway supply firms, the association would have died in its infancy; but the organizers of the association builded better than they knew, as its forming was the means of bringing the hard, many-sided work of the traveling engineer into conspicuous light, showing our managements the great worth of the hard-working, painstaking men who were acting in the capacity of traveling engineer.

The benefits to the traveling engineers have also been great. Twenty years ago he was considered nothing more than an engine-tamer and trouble-doctor, but to-

day he is considered an indispensable adjunct to any well-organized locomotive department, and when I inform you that during the life of the association 247 of our members have been selected to fill higher and better positions in railroads and other walks of life—some of them holding the highest positions in the gift of railroads—and all the members selected have been hard workers in the association, there has been up to date 153 subjects investigated, discussed and acted upon and recommendations made, over 90 per cent. of the recommendations being adopted either in part or as a whole, that we have been recognized by the Master Mechanics' Association to the extent of requesting a representative of our association to be present at their annual meetings (for the past 15 years), that our annual reports are eagerly sought after by technical schools and societies in this and other countries, that we have constantly maintained the good will of the railway newspaper and railway supply world, that we have grown from a membership of 53 to 881, and during that time the membership has shown a steady increase, that very nearly all of our members who have been promoted to higher positions continue their membership, thus giving us their moral as well as financial support, and that today we are in the list with the foremost railway associations in the country, makes us believe that the pride we feel in our association is pardonable.

Railroad Notes.

The Mobile & Ohio has ordered two Mikado locomotives from the Baldwin Locomotive Works.

The Elgin, Joliet & Eastern is planning to build new shops at Joliet, Ill., for the repair of steel cars.

The Great Northern has ordered ten six-wheel switchers from the Baldwin Locomotive Works.

The Virginian railway has ordered eight Mikado locomotives from the Baldwin Locomotive Works.

The Central of New Jersey has ordered five ten-wheel locomotives from the Baldwin Locomotive Works.

The Chicago, Burlington & Quincy has ordered twenty-five locomotives from the Baldwin Locomotive Works.

The Korean National Railways are said to have ordered twelve locomotives from the Baldwin Locomotive Works.

The Canadian Northern has ordered four Pacific type locomotives from the Montreal Locomotive Works.

The Chicago & Western Indiana has ordered five mogul locomotives and five eight coupled switches from the Baldwin Locomotive Works.

The Wabash is making plans to erect new locomotive shops at Decatur, Ill. The cost will exceed $750,000 and will be the main shops of the system.

The Grand Trunk has ordered 2,000 30-ton box cars from the Pressed Steel Car Company, and 50 tank cars from the American Car and Foundry Company.

The Pittsburgh & Lake Erie has ordered 500 gondola cars from the Pressed Steel Car Company, and 500 gondola cars from the Standard Steel Car Company.

The Grand Trunk plans to begin work at once on a line from Port Burwell, Ont., northwest via Calton, Aylmer, Mapleton and Belmont, to London, about 40 miles.

The Atlantic Coast Line proposes to double-track its entire line from Richmond, Va., to Jacksonville, Fla., a distance of 575 miles. The work is already in progress.

The New York Central Lines have ordered 50 Mikado locomotives from the American Locomotive Company, and plans are being prepared for 40 of a similar type for the Lake Shore & Michigan Southern.

The Central of Brazil has ordered two ten-wheel locomotives with 21½ x 28 in. cylinders, driving wheels 68 ins. in diameter, and a total weight of 158,000 lbs. in working order, from the American Locomotive Company.

The Minneapolis & St. Louis has ordered two superheater consolidation (2-8-0-S) freight locomotives with 22½ x 30 in. cylinders, driving wheels 60 ins. in diameter, and a total weight of 187,000 lbs. in working order, from the American Locomotive Company.

The Gainesville, Oklahoma, & Western has begun work, it is said, on the line projected for some time from Gainesville, Tex., southwest via Era, Slidell, Greenwood and Cowan, to Bridgeport, about 56 miles. H. M. Aubrey, president, San Antonio.

The Southern Railway has ordered five Pacific type passenger locomotives from the Baldwin Locomotive Works. This is in addition to the order for 30 Mikado freight locomotives to the Baldwin Locomotive Works and ten Pacific type locomotives to the American Locomotive Company.

Books, Bulletins and Catalogues

New Fay-Egan Catalogue.

J. A. Fay & Egan Company, manufacturers of "The Lightning Line" of woodworking machinery, have just issued a new catalogue which is of interest to every owner and user of woodworking tools.

This catalogue, known as No. 86, is gotten up in a size convenient for handy reference and in its 352 pages are illustrated and described all of the many improvements made in woodworking machines during the past year.

This catalogue is really a text book on woodworking machinery, and is evidently an expensive proposition to print and circulate. The Fay & Egan Company advise us, however, that they will be glad to send a copy, charges prepaid, to any owner or user of woodworking machinery who will address them on his own or company's letter-head as follows: J. A. Fay & Egan Co., 445 West Front street, Cincinnati, Ohio.

Shearing and Riveting Press.

Catalogue No. 87, describing and illustrating the new Watson-Stillman hydraulic coupler yoke shearing and riveting press, has just been published by the Watson-Stillman Company, 50 Church street, New York. This machine shears riveted coupler yokes from their couplers or clamps and rivets the couplers and yokes together with a single stroke of the ram. A free copy of the catalogue will be mailed on application.

Mechanical Tools.

The L. S. Starrett Company have just issued a neat illustrated booklet descriptive of their Chicago store. The offices and stock rooms are models of their kind, and the establishment will be found to be a great convenience to dealers in Chicago and the Middle West. As to the company's fine products, as makers of mechanical tools they are recognized the world over as the standard in quality, accuracy, workmanship and finish. Their Chicago office is located at 17 North Jefferson street.

Notes on Railway Signaling.

With increasing weight of rolling stock and increasing volume of traffic the subject of railway signaling grows in importance year by year. Associations are being established in many countries of those interested in railway signaling. Volumes and reports are published looking towards the spread of information on the subject. Among the more recent publications is an elementary handbook on the subject published by the Locomotive Publishing Company, London, England. The work is from the pens of J. Parsons and B. W. Cooke, two eminent engineers, and while the book refers largely to British practice it is a valuable contribution to the signaling literature of our time. The authors wisely begin at the beginning and lead the reader on through the development of signaling to the state and condition in which it is today, and it is not too much to say that it is by such interesting work placed in such engaging form that the future development of signaling may lead to a higher degree of perfection. The work is finely illustrated, and the letterpress and binding are excellent. Price, seventy-five cents.

Lohmannized.

We have received from the Lohmann Company, 50 Church street, New York, a handsome illustrated pamphlet, treating in a most intelligent manner, details of the Lohmann process for the protection of metals. This pamphlet gives information that ought to be possessed by every person interested in protracting the durability of metal. The facts are stated in a clear and comprehensive fashion that will be readily understood. We understand that this valuable contribution to engineering education is given away free. Any person wishing to obtain a copy should apply to J. H. Maddy, 50 Church street, New York.

Stay Bolts.

A new folder issued by the Falls Hollow Staybolt Company, Cuyahoga Falls, Ohio, presents in a concise and interesting way seven reasons why hollow staybolts should be used in the construction and repair of boilers. Their use has stood the test of time and the growing demand for them is the best proof of their utility. Send for a copy of the new folder and be convinced.

Instruction on the Wabash.

Locomotive engineers on the Wabash have organized a school of instruction to improve their education and that of the firemen in the handling of locomotives and combustion of fuel.

The railroad company has co-operated by furnishing a car equipped with the apparatus the men have to handle, and an electric stereopticon for showing pictures of every-day occurrences. An experienced instructor is employed by the organization and the car moved to the division points where employees are able to take advantage of the instruction afforded. The organization has 750 members. During the last trip of the car of 118 days, stops of from seven to ten days were made at eleven points and there was a total attendance of 1,324 at the lectures.

New York, Westchester and Boston Railroad.

Operating in connection with the New York, New Haven & Hartford Railroad is the New York, Westchester & Boston Railroad which runs from about 180th street, New York City, as a four-track road to Mt. Vernon, where it divides, one section of two tracks extending to White Plains, N. Y., the other section of two-track to New Rochelle.

The power for operating this high-speed interurban railroad is obtained from the power house of the N. Y., N. H. & H. R. R. and 10,000 volts, single-phase alternating current is used on the trolley. Our illustration, Fig. 1, shows one of the steel cars. These cars are run in trains and controlled by the multiple-unit system. The cars are 70 ft. 4 ins. over bumpers and are of the most modern construction. All of the electrical apparatus is mounted under the car-body with, of course, the exception of the two pantograph trolleys used for collecting the current from the overhead wire. This railroad is the most modern up-to-date interurban railroad yet built.

ELECTRIC CARS ON THE NEW YORK, WESTCHESTER & BOSTON RAILROAD.

New Engine House at Garrett, Ind.

The Baltimore & Ohio Railroad has arranged to construct a new engine house of 18 stalls which is to be 100 ft. in depth and an oil house 34 ft. wide by 50 ft. in length at Garrett, Ind. Both buildings will be constructed of brick with composition roofs. The road has also let a contract for a center pit 150 ft. long, wide enough to admit engines on two parallel tracks. In addition to this there will be a frame gravity coaling-station, having a storage capacity of 8,000 tons on which engines can take coal from any one of two tracks. A sand house will also be constructed having a capacity of 500 tons. Besides, there will be two concrete inspection pits 30 ft. in length. The improvement including track changes will cost in the neighborhood of $200,000.

Plans and specifications for these improvements were prepared by M. A. Long, architect for the Baltimore & Ohio.

The New Quebec Bridge.

Work is progressing rapidly on the new Quebec bridge. Last year the debris of the fallen structure, a vast mass of tangled steel, partly above the water and partly submerged, was removed and new caissons were sunk, so that the work on the substructure may be considered well enough advanced to predict a completion of the new bridge in 1915. The bridge when finished will be one of the greatest of its kind in the world. Pending its completion, trains of the new Transcontinental will be transferred across the St. Lawrence by ferries.

Who Came Next?

A teacher was hearing the class in civics and asked this question: "If the Premier and all the members of the Cabinet died, who would officiate?" The class thought for some time, trying in vain to recall who came next in succession. James at last had a happy inspiration and he answered: "The undertaker."

Realistic.

During one of his presidential trips Mr. Cleveland, accompanied by Secretary Olney, arrived at a town in a heavy storm, and they were driven from the station with hailstones rattling on the roof of their carriage. A brass band, undismayed by the weather, bravely stuck to its post and played the welcoming airs.

"That is the most realistic music I have ever heard," remarked Mr. Cleveland.

"What are they playing?" asked the Secretary of State.

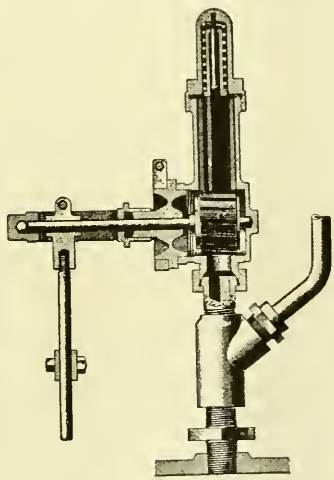
"'Hail to the Chief,' with real hail."

Average Woman's Aim

A suffragette lady went in for stone-throwing on a large scale. She collected a nice lot of heavy stones and proceeded to throw them one by one at short range at a very large plate-glass window belonging to an inoffensive draper. Nine stones she threw, and all missed the mark. She was very angry with hersef and with everybody else because the stones would not go straight. Therefore, when a gentleman standing by laughed aloud the lady immediately threw the remaining stone at him, and—shattered the window.

Slide Valve Lubricator.

The use of graphite as a lubricant has called into use some clever devices having for their object the mixing of oil and graphite in the lubrication of valves. One of the most recent inventions is shown in the accompanying illustration. The lubricator, as shown, stands in a vertical position screwed into the steam chest lid. The upper part of the lubricator is adapted to receive pieces of graphite one inch in diameter by one inch in length. A spiral spring in the upper part of the receptacle causes a downward pressure upon the pieces of graphite. A wheel having its motion from the valve stem or some part of the valve motion is secured in a casing and in its movement has the effect of gradually cutting a portion of the graphite from the piece coming in contact with the fluted face of the wheel. Between the wheel casing and the steam chest there is an attachment adapted to receive a superheater spray pipe or oil pipe from the cab. The National Graphite Lubricator Company of Scranton, Pa., manufacture the article, and a patent has been granted to L. S. Watres, as the inventor.



SLIDE VALVE LUBRICATOR.

A Boomerang.

Pat was over in England working with his coat off. There were two Englishmen laboring on the same railroad, so they decided to have a joke with the Irishman. They painted a donkey's head on the back of Pat's coat, and watched to see him put it on. Pat, of course, saw the donkey's head on his coat, and, turning to the Englishmen, said, "Which of yez wiped your face on my coat?"

It is only when we stop playing that we begin to grow old.

Brained, Yet Alive.

Do you see that big fat engineer over there? Does he look like he had his brains knocked out? hardly. Well, you ought to hear him tell about it, but he won't do it if you ask him, so I will give you the story as he told it to me. It was a long time ago, when he was firing on a new road in one of the middle States.

One night as they pitched over a long hill he took the big tallow pot and went out on the running board to oil the valves. That was before the time of inside oilers. I suppose he was a little sleepy, and, being used to the work, a little careless, and the result was that he walked off the end of the footboard and went headlong into a sandy cut. The engineer missed him in a few minutes, as he did not come around to oil the right valve, and stopped. As the train was running very fast they had no idea but that the poor fireman was dead as a clam.

When our fat friend struck terra firma he woke up, rolled over a few times, and finally found himself in a sitting posture in the ditch. He says he was dazed, and hardly knew what happened yet, but feeling something warm running down his face and neck he thought to himself, "it must be blood; I am badly hurt." Says he felt no pain. Then he put up his hand and felt for the wound; it was bright moonlight and, as he brought his hand down in front of his eyes, he saw that the clotted stuff upon it was white instead of red.

"It is my brains," he said to himself, "and I am a dead man." He said then that he saw the lights of the train coming back for him, and wondered if he would live till they got there. They found him seated so, and kind hands lifted him into the baggage car. With a trembling voice he gave the engineer a message for his mother and a certain girl that lived three doors west of his home, and bid his old friend good-bye.

About this time a small man elbowed his way through the crowd, and the conductor said: "Here is a doctor."

"Bring a good light," said the master of ceremonies. It came, and the doctor commenced to feel of the victim's legs, arms and shoulder-blades. "I'm all right except my head," said Fatty. The man of pills ran his fingers lightly through the clotted mass on the bushy head and said: "The skull is not fractured; why, this is grease tallow."

Well, then that engineer just let out one war whoop and went into hysterics, and everybody laughed till our fleshy friend got mad and broke out of the crowd and went to the engine. It seems that when he fell, the tallow-pot, as usual, fell on top, and from that day to this he has gone by the name of "Tallow-pot."

It was one of those incidents which he will never outlive.

Wireless Telegraphy.

Recently the United States Signal Corps has developed a new form of generator for use with its portable wireless telegraph sets. It consists of a small generator, the rotor of which is driven by hand cranks through a suitable gearing. Two cranks are provided, so that two men may drive the motor at the same time, and if necessary four men may be employed—two at each handle. A low and high speed release is provided, which disengage the driving gear when the speed rises above or falls below a predetermined limit, so that the rotor may be kept at a fairly constant speed. The generator is capable of turning out about 200 watts, and it is light enough to be packed on a mule. The portable generating set has a sending capacity of about fifteen miles.

Just as Good.

The minister of a church in Aberdeenshire was greatly pleased by the knowledge of his Catechism displayed by a bright urchin. After a series of questions on religious knowledge, all of which were satisfactorily answered, the clergyman next asked: "And now, my little friend, have you ever read the Thirty-nine Articles?" "No, sir," replied the youngster, anxious to display his knowledge, "but I've read the 'Forty Thieves.'"

The manager of an engineering works was watching an apprentice who was swinging the hammer in a leisurely way.

"Look here, my boy," he said, going up to the youth and taking the hammer from him, "when I see a man take his hammer by the end of the handle and strike a proper blow—like that—I give that man fifteen dollars a week; but a man who takes it in the middle—like this—only gets twelve dollars a week, and is dismissed whenever we get slack. See?"

But the lad requested an extension of the lesson.

"Please, sir," said he, "where ought I to hold it for my four dollars a week?"

"Some dawgs has more intelligence than their masters." "To be sure they has. I've got one like that meself."

Little boy at booking-office: "I want a return ticket, please." Booking Clerk: "Where to?" Little Boy: "Why, back here of course!"

Sunday School Teacher: "Now, John, can you tell me who took the sulks when the Prodigal Son came home?" John: "Please, Miss, the fatted calf."

School Mistress: "Now, Jimmy, repeat a sentence embodying the word 'seldom.'" Jimmy: "My father used ter have a couple of pigs, but he selled 'em."

Filing Flat.

In the August issue of RAILWAY AND LOCOMOTIVE ENGINEERING is an able article on "Knowledge and Skill," in which the writer states "I do not believe that any man knows how he files flat."

I believe that there is a reason for everything and although a great many file flat without knowing how they do it, still there must be a way to analyze this accomplishment.

My idea of an explanation is as follows:

The operative faces his work with his shoulder line at an angle of about 45 degs. to the work in hand.

His left foot is forward of his right about 12 inches, his two legs forming the necessary braces for his body, which should pivot at the waist line.

The file is laid upon the work with the handle in the palm of the right hand and the other or free end of the file over the index and second finger and under the thumb of the left hand.

The arms being "pivoted" at the shoulders would swing in an arc if free, but with the file held firmly, will become the same as a pair of parallels, the only requirement being to move the elbows sufficiently to overcome the foreshortening of the arms as they swing.

An apprentice should be told to "bear down" on the left hand as the file is started and gradually increase the pressure as the file is advanced.

It is quite common practice in filing "oval" to start the file with the handle at the low point and "go over," cutting the near side of the work first. In my opinion it is much more workmanlike to start the cut on the far side with the file handle up, and press down on the handle as the file is advanced.

To man it is said, you do not live for yourself. If you live for yourself you shall come to nothing. Be brave, be just, be pure, be true in word and deed; care not for your enjoyment, care not for your life, care only for what's right. So, and not otherwise, it shall be well with you.

A responsible position is seldom given to a man. It is rather a matter of conquest; a position captured at the sword point of initiative. When a man once assumes responsibility and shows he can make good, he will find that almost every one else is quite willing he should continue his task.

"Mirth is God's medicine," said Dr. Oliver Wendell Holmes, "everybody ought to bathe in it. Grim care, moroseness, anxiety—all the rust of life—ought to be scoured off by this oil of mirth."

If happiness has not her seat and center in the breast,
We may be wise or great or rich but never can be blest.

Positions Open and Wanted

FOREMAN WANTED by large manufacturer of brass specialties. Address Foreman, care of RAILWAY AND LOCOMOTIVE ENGINEERING, New York.

WANTED—Position as Master Mechanic or General Foreman, by middle-aged man with over eight years' experience as Master Mechanic at large Eastern shop. Address Master Mechanic, care of RAILWAY AND LOCOMOTIVE ENGINEERING, New York.

WANTED—Position as Chief Clerk to Superintendent Motive Power and Machinery or Master Mechanic by man 39. Now employed in like capacity on large trunk line. Thirteen years in present position. Good record. Familiar with Government Boiler Inspection requirements. Best of reasons for desiring to make change. Address Chief Clerk, care of RAILWAY AND LOCOMOTIVE ENGINEERING, New York.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXV. 114 Liberty Street, New York, October, 1912. No. 10

On the Bangor & Aroostook.

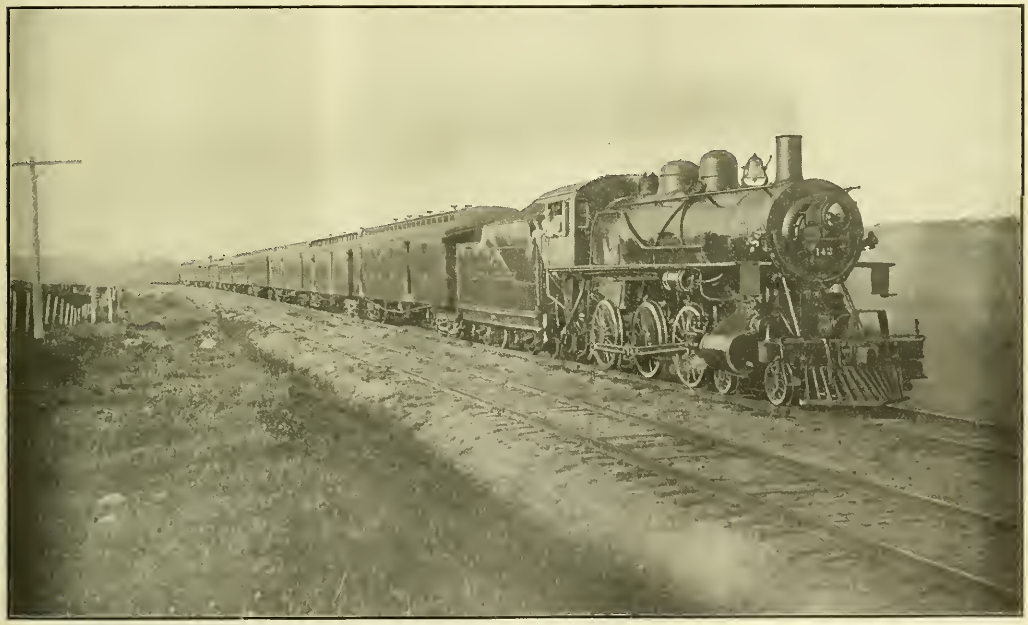
At this season of the year the Maine woods become the nation's playground, and to those who have the opportunity, we cannot imagine anything surpassing the grand beauty and gorgeous coloring that await them in this favored region.

The Bangor & Aroostook Railroad traverses through the most interesting parts of this favored land, and it is greatly to the credit of the enterprising promoters who penetrated the woody wilderness and brought within easy reach of the dwellers in the Eastern cities, scenes of unrivaled variety and ever-changing picturesqueness, together with the opportunities to the lovers of the chase or more properly speaking, to the devotees of rod and gun, to indulge their favorite pastimes under ideal conditions.

It is not to be supposed, however, that it was altogether a desire to afford recreation to holiday seekers that actuated the founders of the railroad. The entire country, from where the road starts from Penobscot Bay to Grand Isle on the St. John River, is dotted with expanding cities and flourishing towns, while the thousands of happy farms owe their very existence to the railroad. The creation of traffic has been accomplished with a degree of success that could only have reached fruition by the exercise of much ingenuity. Success is not always in exact ratio with effort. But genius overcomes many seeming impossibilities.

As an illustration of what the leading spirits of the Bangor & Aroostook have done, it may be mentioned that they managed to introduce coal into a country stocked with timber by appealing to the housewives and showing that coal would lessen their labor. Getting up three times during the winter nights to replenish fading fires is rising to a height of self-sacrifice that may be ennobling, but it is disquieting and the housewives took the hint and the first year after the appeal was made 40,000 tons of coal passed into the new territory, and the amount of coal is still going up.

Logs were formerly floated down the St. John River, taking about two years, before reaching the saw mills. When the railroad reached the river the company erected a saw mill there, and the logs reached the market in a reasonable time, and there are now 75 mills along the line. Then the railroad took up the question of waste timber, and in a few months the kindling wood industry blossomed into being, and traffic grew. Among the items credited to the railroad may be mentioned six large mills where spools for cotton are made calling for nearly 1,000 car loads of freight a year.



TRAIN NO. 3 LEAVING BANGOR, ME., ON THE BANGOR AND AROOSTOOK RAILROAD.

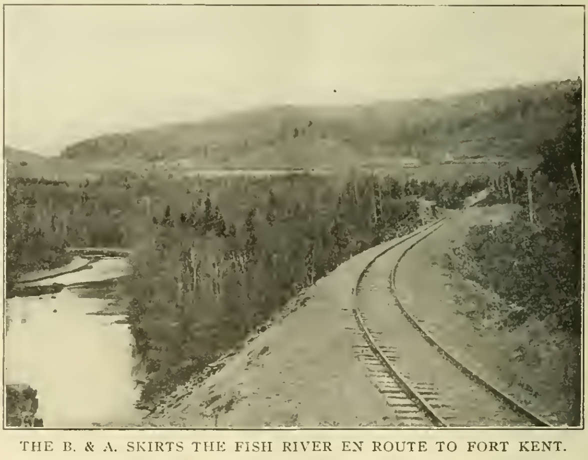
Now it is baseball bats and wooden dishes and teacups. In agriculture it may be truthfully stated that no state in the Union rivals Maine for the quantity and excellence of its potatoes.

Regarding the motive power and rolling stock, our frontispiece illustration shows that the equipment is of the advanced twentieth century type. The picture was taken a few miles out of Bangor and shows the regular train No. 3, which is run from Bangor to Caribou. There are about 100 locomotives and nearly 6.000 cars of all kinds. Ten wheelers seem to be in much favor in the motive power department. The freedom from serious breakages or accidents is noteworthy. The Company was fortunate in securing the services of Mr. Hugh Montgomery as Superintendent of motive power and Engineer. Under his watchful eye and experienced hand the locomotives, and mechanical appliances generally, are kept in a degree of efficiency approaching perfection. Mr. George M. Houghton, the gentlemanly and accomplished passenger traffic manager, in addition to looking out for the comfort and welfare of the traveling public, has the rare faculty of a gifted writer, and the illustrated pamphlets and descriptive guide books from his hand rival the best of European tourist literature. They are text-books in themselves, and the most careless reader cannot fail to be enamored of his delightful descriptions. As to Mr. Percy R. Todd, the omniscient and versatile Vice-President, when he speaks at a social gathering, the vanished eloquence of Dr. Holmes and Mark Twain are forgotten.

In brief, the selection of the right men in the right places is a proof of what team work wisely guided can accomplish in the face of great natural difficulties. Many names of competent officials could be mentioned, all of marked ability, to which must be added the fine personnel of the employees generally, representing the best type of American manhood.

Attached are two smaller illustrations introduced not so much as showing glimpses of the romantic and beautiful scenery through which the road largely passes, but as typical of the substantial structure of the roadway which will compare favorably with much larger roads in more commercially favored districts. The success of the enterprise is assured by the large additions that are in prospect while the constantly increasing stream of traffic during the tourist season shows that the name and fame of the interesting and delightful highway is growing and cannot do other than continue to grow in the minds of the American people.

WHERE THE B. & A. ROUNDS MOSQUITO MOUNTAIN ON THE WAY TO ITS SEAPORT TERMINAL.



THE B. & A. SKIRTS THE FISH RIVER EN ROUTE TO FORT KENT.

Railway Consolidation in South America.

With further reference to the extensive schemes of railway consolidation being carried out in South America by Mr. Percival Farquhar, with the aid of a powerful syndicate of European and American financiers, a further stage was reached on August 19, a payment of $15,000,000 having been made to him by the syndicate for $15,000,000 6 per cent. preference shares of the Argentine Railways Company, an undertaking registered in the State of Maine some months ago in connection with Mr. Farquhar's plans. The company has $30,000,000 ordinary shares in addition to the above-mentioned preference shares.

Mourns for the Drinking Cup.

The cranks whose senseless agitation has eliminated the public drinking cup, even in Pullman cars, have inflicted much discomfort upon ordinary people and have largely increased the business of saloon keepers. The victims that deserve the greatest pity are the poor immigrant children who have need to make long journeys in hot dusty cars. When this pernicious movement against free water drinking has passed, people will wonder at the blindness which enabled cranks and saloon keepers to spread so much discomfort among honest people.

Skillful Train Robbing.

Five masked bandits made a very deliberate job of train robbing last month on the Southern Railroad, near Stephenson, Tenn. They boarded a train, and displaying an armory of weapons ordered "all hands up and everybody lie down." The order was obeyed without protest. Then they compelled the mail clerk to tie the hands of three other clerks while the robbers rifled the registered mail. If the robbers are ever caught we make the prediction that several trainmen will be found among them.

Old Time Railroad Reminiscences.

BY S. J. KIDDER.

During a recent visit to my old New Hampshire home, while rummaging through the attic archives, I came across a railroad guide which, in my boyhood days, was the delight of my heart to peruse, it being the first of the kind I had ever seen and, I think, the pioneer of such publications.

The book is 4 ins. by 2¾ ins. with 88 pages, the front cover being embellished with a wood-cut print of an antiquated 8-wheel, plain-roof passenger car, having ten windows along its side and bearing the announcement, "Pathfinder Railway Guide for the New England States, No. 8, January, 1850." "Issued on the First Monday of Every Month. Containing Official Tables of the Hours of Departure from Each Station, and the Distance and Fares." "Sold by News Agents, Booksellers and Railway Companies."

That railroad officials recognized the importance of organization even at that early day is indicated by an announcement reading:

"Boston, July 1st, 1849.

"The Railway Guide for New England is published the first Monday in each and every month under the authority of the New England Association of Railway Superintendents, by Snow & Wilder.

"W. RAYMOND LEE,
"President of the Asso."

On the inside of the guide cover the publishers, under a cut of a hand press operated with a treadle, announce a "Railway Printing Office" and that they "have largely increased their business facilities by extending their apartments, and putting in operation one of Adams Newly Invented *Fast* Job Printing Presses, which for ingenuity and mechanism, strength of construction and rapidity of execution, is believed to be unrivaled by anything in its department." The book does not give the original price per copy but contains a notice that "when the publication of this work was commenced in July, 1849, sixty pages were found sufficient to contain the Time Tables and Advertisements of all Railroads then operating in New England." "The completion of new roads and the extension of others have, from time to time, required additions to the work," etc. "The price fixed upon at the commencement, affords the publishers no remuneration for the work at its present size and they have consequently, with the approbation of the Association of Superintendents, advanced the price to 5 cents." The announcement concludes: "We feel confident that no one who takes into consideration the great amount of information presented in its pages, much of which the public can obtain *from no other source*, together with the *official* character of that information, will not consider the trifling advance."

The guide contains two maps, one showing the railroads of New England in 1840, the other, those completed and projected in New England and part of New York in 1850.

Two pages are devoted to an article under the caption "New England Railways in 1840," the first paragraph being this editorial announcement: "By the map which we have placed side by side with our ordinary one, it will be seen that with the exception of the New Haven & Hartford and the Bangor & Oldtown, all the railroads in operation at the commencement of 1840 were connected with four main lines diverging from Boston.

"Of these we find a succinct account in a paper furnished by Nathan Hale, Esq., to the 'Boston Almanic' of that year, from which we extract the following particulars:

"'It is less than ten years since the first charter of any of the existing railroads was granted by the legislature of Massachusetts and less than six years since the first locomotive engine employed in New England for the transit of passengers, began to run on a part of the Boston & Worcester Railroad, from Boston to Newton. There are now constantly running, thirty or forty locomotive engines, on railroads terminating in Boston, transporting a large part of the merchandise and produce for the supply of the city, and of this state, producing a daily movement of population vastly exceeding any former precedent and promising to introduce an entire change in the habits of society.'"

"The article then goes on to state that 'These railroads form four distinct lines, each line consisting of several parts, more or less independent of each other, and each terminating at some convenient point in Boston.' These distinct lines are: (1) The Boston & Providence Railroad, 41 miles in length, running to the navigable waters of Narragansett Bay. There it is met by the Stonington Railroad, which continues from Providence, a further distance of 47 miles, through Rhode Island and Connecticut to the port of Stonington on Long Island Sound.

"Appended to and diverging from this line is the Taunton branch, running in a remarkably straight course 11 miles to Taunton. Another branch extends from the main road to Dedham, two miles. The length of these connected lines of railroad being 121 miles.

"(2) The Boston & Worcester Railroad, leading from the South Cove on Boston Harbor, 43 miles to Worcester. There it is met by the Western Railroad, completed to Springfield, Mass.

"At Worcester the line is also met by the Norwich & Worcester Railroad, extending 59 miles to the city of Norwich in Connecticut."

The statement concludes by referring to a branch three miles in length and "the extent of this connecting line of railroads, as far as it is already finished, is 161 miles.

"(3) The Boston & Lowell Railroad, 26 miles in length, the Nashua & Lowell, extending from the termination of the former, a distance of 14 miles, a branch 16 miles in length and nearly completed to the New Hampshire line, where it is to connect with the Boston & Maine, nearly 17 miles in length, which will be an extension of this branch.

"(4) The Eastern Railroad, already completed from Boston to Salem, 12 miles, and which has been in operation more than a year."

The number of miles of finished railway connecting with Boston (1840) was 357. With the Bangor & Piscataquis, 11 miles, and the New Haven & Hartford, 36 miles, the number of miles in New England was 404.

The total number of passenger trains then leaving Boston daily from all stations was 17. Ten years later the number of miles of railway in actual operation, in New England was 2,300 with an estimated cost of construction, not less than $100,000,000. The number of passenger trains leaving Boston daily was:

Old Colony	8
Boston & Providence	13
Boston & Worcester	19
Fitchburg	22
Boston & Service (Sundays, 13)	12
Boston & Maine	17
Eastern	8
Total	99

Of these more than 61 per cent. were local trains running but a few miles out of Boston.

The progress thus exhibited is doubtless without a parallel in railway history.

Canadian Railways.

The total railway mileage in Canada for the year ended June 30, 1911, was 25,400, an increase of 669 miles over the previous year. Of this gain, 70 per cent. was in the western Provinces. The cash subsidies paid for railway construction in the Dominion up to the end of June of last year were as follows: From the Dominion, $148,217,071; from the Provinces, $35,919,360; and from the municipalities, $18,042,823. The land grants to the railways totaled 55,256,429 acres, of which 32,004,486 acres were given by the Dominion.

The number of employees was 141,224. The wages and salaries paid amounted to $74,613,738. There were in use 4,219 locomotives, 4,513 passenger service cars, 127,158 cars in freight service and 9,578 cars in company service. The engine sumed was 111,975,176. The feul consumed by locomotives during the year 1911 aggregated 6,800,648 tons, costing $20,182,103.

General Correspondence

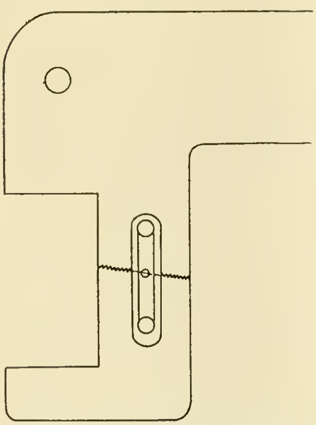
Repairing Broken Guide Yoke.

Editor:

Attached is a sketch showing method of repairs to broken guide yoke on mastodon type engine. This engine was equiped with guide bars of alligator style and broke guide yoke between top and bottom guide bars, as shown. Two holes were drilled at equal distances from the break to fit draw bar knuckle pin, which were cut off long enough to extend through on each side of yoke 1⅛ inches. Two bands were made, as shown, out of 1 inch square iron and allowance made for shrinkage. After bands had been shrunk on a small hole was drilled through the center of break, and bolt and washer applied to draw bands together to guide yoke. The engine that this repair wås made on was in service over a year before receiving general repair when guide yoke was renewed and during that time no trouble was experienced on account of broken yoke. Yours truly,

M. F. Gosswiller.

Troy, Montana.



REPAIR ON BROKEN GUIDE YOKE.

Another Freak Locomotive.

Editor:

It would be hard beating the old-timers that are occasionally shown in the pages of Railway and Locomotive Engineering, but we have a curiosity here that is in a class by itself. It is used for shunting purposes in the yards of the Dunton Green Brick Company, which adjoins the London and Dover main line of the South Eastern and Chatham railway, near the prosperous town of Sevenoaks.

It was originally built as a traction engine to run on the common highways at Rochester in the county of Kent, about thirty years ago, and was afterwards rebuilt or converted to run on rails by placing cast-iron flanged wheels under the engine. The rear pair of wheels are connected by teethed wheels to the crank axle on which there is a spur wheel en-

ANOTHER FREAK LOCOMOTIVE.

gaging the rear axle, on the opposite side to the fly wheel. The latter wheel is an abiding necessity, as there is only one cylinder. There is a link motion reversing gear, but no kind of a brake is attached. The speed is not great, as the owners have had the good sense to reduce the steam pressure with advancing years. It pulls five or six ten-ton cars, and looks like Artemus Ward's combined wheelbarrow and grindstone.

J. B. Williams.

Enfield, England.

Frame Breakage.

Editor:

I have read the opinions of your correspondents on the subject of "Frame Breakages," and venture to state that I do not altogether agree with their views. As we all know the early American locomotive was light in weight, and the bar frame, which is a medley of rods, bars, bolts and pins, did very well in these early days. The yielding road-beds placed no undue strain on the bar frame. The weight of the locomotives increased, but the bar frame remains, and this is the weak point in American locomotive construction.

The once yielding road-beds are now solid, with heavy steel rails, and have practically no elasticity, and with the great weight of the locomotive resting entirely upon the bar frames the result is that the frames yield and stretch with the result that broken rods are of frequent occurrence. All British and nearly all European locomotives have plate framing, and as this kind of frame is strongly made and substantially rivetted together, it is rigid and durable and breakages are unheard of.

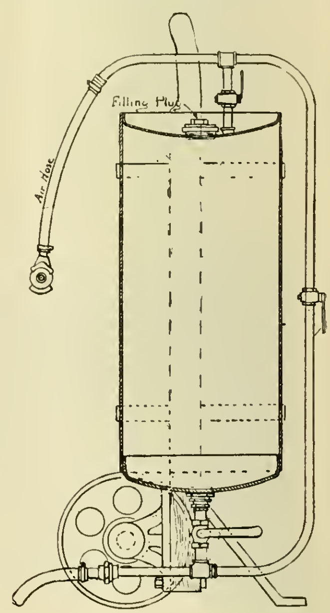
I am convinced by practical experience that the tendency to breakage in bar frames is unavoidable, and if the plate frames were applied to American locomotives, not only the frames but the life of the entire locomotive would be greatly prolonged. Richard G. Nichols.

Victoria City, B. C.

Sand Blast Apparatus.

Editor:

The accompanying drawing shows the details of a sand blast machine which can be cheaply built by any machinist or pipe fitter. It has proved itself very useful in sand blasting tenders that are badly pitted. This machine does rapid and good work and, of course, its operations are best suited for the open air. As shown in the illustration, the apparatus is portable, and the hose attachment may be lengthened to suit any condition. The nozzle



SAND BLAST APPARATUS.

may be made of brass and the opening need not be more than one-quarter of an inch in diameter at the point, and tapering inwardly for four inches to a diameter of half an inch. The socket and other at-

tachments should be free from sharp corners. A machine of this kind is not only easily made, but will speedily pay for itself. CHARLES MARKEL.

C. & N. W. Ry, Shop Foreman.
Clinton, Iowa.

Drilling Hand Rail Brackets.

Editor:

Enclosed are sketches of two holders for holding hand rail brackets when drilling and tapping same. Sketch

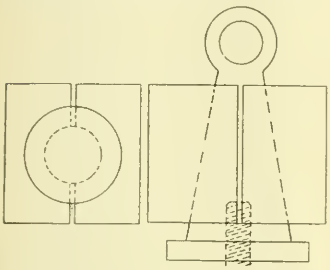


FIG. 1. FIG. 2.

No. 1 shows end view and Sketch No. 2 shows side view, while Sketch No. 2 shows also a bracket clamped in position for drilling the end hole for hand rail to slip through. The jaws of the holder are the same taper on the inside as the bracket, thus holding the bracket firm when jaws are set together. Sketch No. 2 also shows top view of bracket, showing hand rail hole at top end, and tapped hole at base to screw stud or bolt into to fasten same to boiler. Sketches No. 3 and 4 show bracket in position set in a set of tapered jaws, and the jaws are held together around bracket by laying old lathe chuck flat upon drill press table

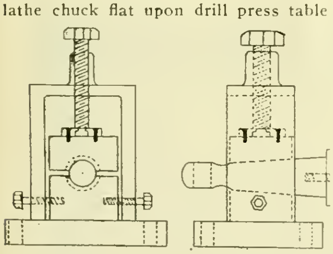


FIG. 3. FIG. 4.

and clamping bracket jaws in chuck. In this position the end hole is drilled and tapped by drill press power to standard size. The device is simple and effective. JOHN W. PERCY.

So. Tacoma, Wash.

Lathe Dogs.

Editor:

Enclosed are sketches of two kinds of safety lathe dogs. Fig. 1 represents edge

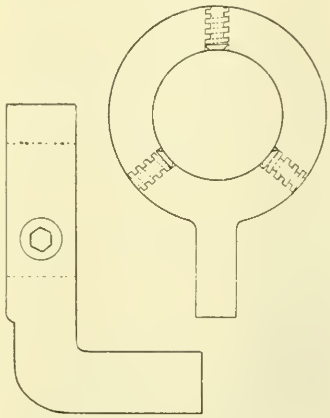


FIG. 1. FIG. 2.

view and Fig. 2 end view of a dog, with three of the Allen safety set screws in for gripping the work. This dog to be used on jobs near to the size of bore of dog as any other dog used in like manner. With this dog three set screws are driving at the same time, while with the old-style of dog only one set screw was used. Fig. 3 shows edge view, and sketch Fig. 4 end view of another style of lathe dog. This dog is used on special work, such as knuckle pins, cross head pins and the like. This dog, of course, is threaded on the inside standard for the job to be used on. It screws nicely on new pins to be finished on center bearing and taper fits. When second-hand pins are to be skinned up on bearing and this dog does not go on smoothly on threaded end the lathe hand knows that the roundhouse man will have trouble getting the nuts on the pin again, so the lathe hand chases up the threads first, so the dog will go on freely. This threaded dog is then a check on the threaded end of pins. It is hardened on the inside.

These two dogs are the result of good

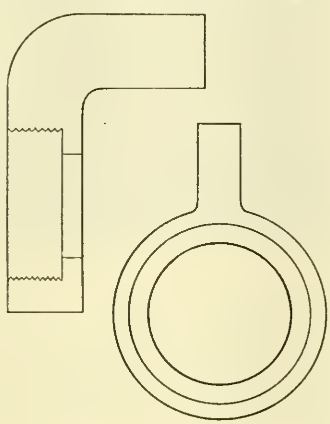


FIG. 3. FIG. 4.

thought on the part of one of our alive and up-to-date thinking lathe hands, Chas. W. McAtee.

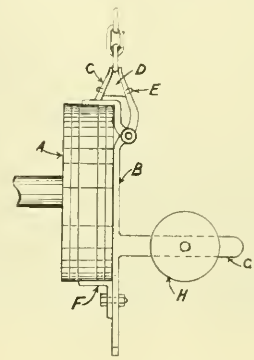
JOHN W. PERCY.

So. Tacoma, Wash.

Piston Handling Device.

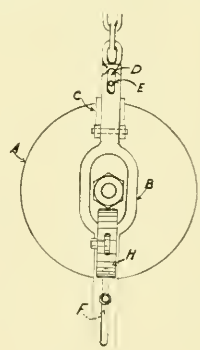
Editor:

The enclosed drawing shows an engine piston handling device whereby the piston will hang vertically when withdrawn from the cylinder. Referring to the



PISTON HANDLER.

drawing, A is an engine piston, B is the main lever of the piston clamp, C is a top lever, and D is a triangular block. The balancing pins are shown at E and the adjustable bottom clamp at F. The bottom counterweight rod G supports the counterweight H.



PISTON HANDLER.

The device is in constant service at the Canadian Pacific here, and greatly facilitates piston handling.

It will be readily understood that the chain attached carrying the weight of the piston may be attached to such appliances as may be conveniently located overhead. With a traveling crane the piston may readily be conveyed to any point desired.

J. G. KOPPELL.

Montreal, Que., Canada.

In China.

Editor:

On the Canton Railway in China the equipment is largely American, and the native engineers and firemen are very trustworthy, and accidents are of rare occurrence. The traffic is light, even in the most densely populated localities, and it is very curious to observe that as soon as one leaves the railroad the primitive rickshaw and other conveyances of antiquity are in evidence. Enclosed are photographs of a train in the Canton Railway, and a view of the traffic on one of the principal streets in Canton. It will be noted that the monorail, or monowheel, rather, is in full operation. The feats of balancing of the monowheel men are quite startling to a stranger, but the passengers on the one-wheeled conveyances seem to have the happy faculty of helping to retain the equilibrium of the simple machine. It was readily observable when a passenger stepped off, that those in the heavier side sat nearer the center, while those on the lighter side moved slightly away from the center. It was a fine example of team work, and all in silence. Those who think that the monorail is impractical should take a trip to China and have their eyes opened.

J. Lodian.

New York, N. Y.

ON THE RAILROADS IN CHINA.

Large Locomotive Boilers.

The *English Mechanic and World of Science* published the following letter on September 6:

"The difficulty of designing an express locomotive nowadays is, I believe, to get a sufficiently large boiler on top of the driving wheels. Could not this difficulty be obviated by designing an engine in the following manner?

The locomotive would consist of two cars or trucks; on the front one would be the cylinders, but no boiler In order to increase adhesion, a large amount of coal might be carried above the cylinders. The rear car would carry the boiler, which might be of a diameter limited only by the loading gauge. The firebox would be at the front part of the boiler, the smokebox being, of course, at the back. The steam-pipe would be flexible metallic tubing.

"The advantage of such a locomotive would be that large drivers and powerful cylinders could be used; also the boiler could be made with a large heating surface. One disadvantage is that there would not be much weight available for adhesion, but surely this might be obviated by carrying a large supply of coal and water, or even by loading with scrap-iron, etc."

For the information of those who might be interested in the above scheme, we would like to direct attention to the Nichols "Novelty" built for the Philadelphia & Reading Railroad about 1846. The designer of that locomotive wanted to provide an unusually large firebox for burning anthracite coal. The boiler was carried to two pairs of 4-wheel trucks, and the engine part on a separate frame, having four pairs of driving wheels connected. The firebox had 36 square feet of grate area, and the boiler provided 1,085 square feet of heating surface. The engine was a failure, principally for want of the necessary adhesion.

The Nichols "Novelty" is illustrated and described on page 284 of Sinclair's "Development of the Locomotive."

Chicago to Have Station Accommodation.

For a great city Chicago has always been noted for lack of proper railroad station accommodation. Travelers between the East and West have always been put to great inconvenience in changing stations, and now the prospects are that a most desirable change is about to be inaugurated. The following dispatch from Chicago to the New York *Sun* tells the welcome tidings:

"Backed by the great money resources of private bankers and the assets of fourteen great railroad companies, an enterprise involving a cost of $200,000,000 promising a complete solution of the hitherto baffling problem of freight handling in Chicago has been definitely launched.

"The papers were signed recently by representatives of the interests concerned. The bonds will be issued as fast as the money is needed. The first issue of $25,000,000 worth will be floated at once, the Morgan interests having agreed to take the entire lot.

ON THE STREETS IN CHINA.

"At a secret meeting in Chicago recently the plans were discussed and ratified in every detail. The agreement was signed by representatives of J. P. Morgan & Co., the New York Central,

the Pennsylvania, the Chicago and Northwestern, the St. Paul, the Burlington, the Illinois Central, the Chicago and Alton and all the big trunk lines entering Chicago.

"One-half of the $200,000,000 bond issue will be set aside for the construction of passenger and freight terminals.

"Fifty million dollars will be used in purchasing the Chicago Union Transfer Company. The rest will be used to take up the bond obligations of the Western Indiana.

"A great passenger and freight terminal will be erected on the site bounded by Polk, Sixteenth, Clark and State streets. And it is understood that all the big roads concerned will bring their passenger trains into that huge receiving station."

Wonders of Cottonseed.

Up to the close of the American civil war little or nothing was known of the real value of cottonseed. It was generally regarded in the South as a waste and an incumbrance. There were laws prohibiting the dumping of the seed in running streams. To allow it to accumulate around the plantation houses was simply to promote a nuisance. A few, however, had seen some possibilities of putting the seed to use. With the return of peace and the revival of the textile industry, the idea of crushing the seed and extracting oil from it took form. By 1880 this industry had grown to the point where it had a commercial value of about $7,000,000. But even then there was no general appreciation of the possibilities of cottonseed as a wealth producer. Much of it was still going to waste. The *Manufacturers Record* is authority for the statement that an industrial exposition is now planned for Dallas, Tex., the main purpose of which is to exhibit the products of cottonseed.

Speaking generally, people now eat and wear cottonseed products and do all manner of things with them. The lintels yield batting, wadding, stuffing for pads, cushions, comforts, horse collars and upholstery, mixing for shoddy, for wool in hatmaking and for lambs' wool in fleecelined underwear; also for felt and low grade yarns used in making lamp and candle wicks, twine, rope and carpets; also cellulose used in making artificial silk and writing paper, and as a basis for explosives.

But this is not all. The hulls are used in feed, fertilizer, paper stock and stuffing. The cake and meal are also used in fertilizers, in dyestuffs, in feed for cattle, poultry, horses and swine, as well as in confectionery and flour. The oil enters the manufacture of lard compounds, white cottolene, butter oil, cooking oil, salad oil, "olive" oil and oleomargarines. It is used in the packing of olives and sardines, in miners' oil, in lubricating oil, in paints, in mixing for putty and in automobile tires. It is an ingredient of soap, washing powders, etc. Altogether there are fifty-three products. Millions of capital and thousands of persons are employed in the industries growing out of the use of cottonseed. In this connection the *Manufacturers Record* says: "Edward Atkinson of Boston, who in his life rendered valuable service to the industrial South in his statistical presentation of conditions there, took the ground a quarter of a century ago, as we recall it, that the cottonseed, weighing twice as much as the fiber, would some day be worth quite as much."

There certainly is encouragement for the belief that this prophecy will be fulfilled. The history of the cottonseed industry in the last forty years is full of marvels. An exposition that would present objectively its various steps from the beginning should be full of interest and instruction and might be the means of giving a fresh impulse and impetus to discovery.

Railway Signal Beacon.

To call a railway signal lamp a beacon, is a new use for an old term and yet in reality, the Aga flashing signal, as installed by the Commercial Acetylene Company, of New York, is a beacon, no matter what other name it may have, and evidently a good one at that.

For years the mariner has realized the efficiency of a flashing beacon light to warn him of danger at sea, and it is claimed that the Aga flash light can be more readily observed by the men on railways than the ordinary class of signals.

In brief, the Aga light consists of an acetylene burner in a signal lamp, the gas being supplied from a convenient tank in the usual manner employed by the Commercial Acetylene Company.

Close to the flame tips is a small constant light which consumes such an infinitesimal amount of gas as to be practically of no expense.

Under the burner is a diaphragm controller and a reducing pressure regulator which allows the gas to flow to the burner, where it is ignited by the small or constant light above mentioned. The light is then fully shown and the escape of a predetermined flow of gas changes the pressure on the diaphragm and causes the extinguishing of this main light. By this mechanism the light is made to flash about once each second and it is claimed that this type of signal can be distinguished not only at a great distance, but that it is distinctly noticeable, especially in fog and storm.

Labor Bureau on the Baltimore and Ohio.

A movement in the right direction is the establishment of a free Labor Bureau for the purpose of bringing the unemployed or those desiring to better their employment in direct touch with possible improvement on the Baltimore and Ohio System.

A Labor Bureau in charge of Mr. H. R. Bricker, with title of Labor Agent, has been established at the central offices for the purpose of employing skilled and unskilled labor for all grades of railroad service. Branch offices have also been established in Philadelphia, Washington, Cincinnati, Cleveland and Chicago.

Railroads have frequently been confronted with a scarcity of labor at certain points on the line, notwithstanding statistics often presented concerning the armies of unemployed in many American cities, and it is believed that this Bureau which underetakes to bring the job to the man may aid in solving this question of employment for both parties.

The Labor Bureau does not in any way resemble a contract labor system. It is operated for the Baltimore & Ohio service, and, although connected directly with the maintenance of way department, its aim is to supply workers for all departments. Any department desiring to increase the forces notify the Labor Bureau, giving full information as to the character of work, hours of service, wages etc, so that the Labor Agent may fully acquaint the prospective employes concerning the work that will be expected of them. No charge of any kind will be made of those employed for securing positions for them.

Securing More Steam Power.

The United States Bureau of Mines makes the statement in a bulletin just issued that the present steaming capacity of steam boilers can be tripled or quadrupled by forcing over the heating surfaces three or four times the weight of gases now passed over them. The bulletin states:

With well designed, mechanical-draft apparatus this greater weight of gases can be forced through the boilers at small operating cost. It is possible to increase the capacity of many of the present boilers in this way without reducing their efficiency much; in fact, by proper arrangement of the heating surfaces the efficiency can be made higher than the present rating. The efficiency of any boiler can be increased by arranging its heating surfaces in series with respect to the path of hot gases. New boilers of high efficiency can be constructed by making the cross-section of the gas passages small in comparison with the length.

War a Necessity.

While American public men and lovers of mankind in all civilized countries are predicting the coming of one era when men will no longer engage in the barbarous practice of killing each other, consternation has been felt in some quarters by the following article which has just appeared in an influential Paris paper:

"While the pacifists are stirring themselves in all directions in order to hasten the approach of a universal reign of peace, scientific sociologists are uttering cries of alarm. The population in the different states is, in fact, becoming multiplied so quickly that with few exceptions all the nations will find themselves compelled in the struggle for life to create new outlets for people without work, without land, and without money. It is thus that the most prolific countries become for that very reason a common danger for the peace of the world."

Of course, this French writer brings in Germany as a dreadful example, but also couples with that country England, Japan, and the United States, as he says:

"Germany has always been looked upon as a veritable bugbear by the pacifists who are looking anxiously toward the morrow. Within a hundred years Germany's population has been tripled and to-day is to be counted as 64,000,000 souls. At the same time her emigration has always been considerable. From her incapacity to feed all her children she has sent them out in swarms to every corner of the world. In one century she has furnished to the United States alone 6,000,000 immigrants. And yet her own inhabitants are found 303 for every square mile, while France has only 134 per square mile. Added to this is an extraordinary advance in Germany's economic prosperity and this again is a source of danger to the peace of the world."

History of the Saw.

Undoubtedly the saw is one of the very earliest tools known to have been used, and is in fact the earliest tool that has been traced in Egyptian history.

It was found first in the form of a notched bronze knife in the third dynasty, or about 5,000 years B. C., and was followed by larger tooth saws in the fourth and fifth dynasties, which were used by carpenters; but there are no dated specimens until the seventh century B. C., when the Assyrians used iron saws.

The first knives on record were made out of flint, and were in fact saws with minute teeth. They must have been used for cutting up animals, as the teeth would break away even on soft wood.

Rasps, which are but a form of a saw, were first made of sheets of bronze punched and coiled round, but the Assyrians in the seventh century used the straight rasp made of iron exactly like the modern type.

Coming down to modern times, the saw is possibly used more than any other tool. It has taken three distinct forms, both for the working of wood and metals—the straight saw, which is simply a development of the first toothed knife, the band saw and the circular saw.

Danger of Flowing Garments.

During a recent journey, we heard two trainmen railing at the tyrannical tendency of railroad officials to infringe upon the personal liberty of the individual employee, the origin of their complaints being an order issued by the Minneapolis, St. Paul and Sault Ste. Marie to the effect that shop employees will not be permitted to wear loose neckties or torn overalls. That is a very sensible order and something of the same kind ought to be enforced in every shop where men are engaged in operating power tools. A loose flowing necktie may have a decorative effect, but it is a menace to the individual wearing it, if there is a possibility of the ornament engaging in the teeth of any moving gear wheel. Factory inspectors find it necessary to establish very strict rules against factory workers wearing garments with parts likely to be caught in moving machinery, and it is equally just that railroad officials should act to conserve the lives and bones of individuals who do not have sense enough to provide for their own safety.

Foundryman's Tip.

It not infrequently happens in the best regulated brass foundries that a pot will "freeze" just before pouring, and the common practice of running this metal into a "pig" or "buttons" is not only wasteful but unnecessary.

Small pieces of phosphor tin should be kept at a convenient place, easily accessable to the flowmen and should a pot freeze even after it has been skimmed, drop a piece of phosphor tin into it and stir to the bottom. The metal will immediately flow freely and the introduction of the phosphor tin will not materially affect the mixture, but will, if anything, make the casting more fine grained and clear.

The quality of phosphor tin required to produce the desired result will, of course, vary with conditions, but as a rule a piece of about 2 ozs. will "boil" 100 lbs. of metal.

New Michigan Central Shops.

The Michigan Central Railroad Company are about to erect a new roundhouse and car shops at Bay City, Mich.

The new buildings will cost approximately $200,000, while the equipment of machinery, purchase of necessary ground the independent waterworks and sewer system, new trackage, etc., which the company proposes to erect will bring the total cost up to somewhere in the neighborhood of $500,000.

The work on the buildings will be started this fall, and their construction will furnish employment for a large number of laborers and mechanics, while the shops, when completed, will give employment the year around to between 350 and 400 more men than are employed in the present roundhouse and shops.

The Diesel Engine.

According to the London *Times*, the Clyde shipbuilders have an objection against the Diesel engine on the ground of its lack of flexibility as compared with the steam engine, claiming that it must be kept running at a fair speed or it will stop altogether, whereas the steam engine can be run either ahead or astern at any slow speed desired. The makers of reciprocating engines of the smaller marine type state that this is the principal reason why the oil motor is not making more headway. But a Diesel engine consumes less than half the amount of fuel and in every respect far more economical, and hence it is certain that the objection above named will be met and fully mastered; indeed, the reduction gear would solve the problem at once.

Courted Death on Locomotive.

The Southwestern Michigan Fair Association schemed to have as a supreme attraction the spectacle of two ancient locomotives engaging in a butting collision. When the unique show had reached public notice, I. D. Robinson, a resident of Northwest Canada, made application to be permitted to end his days riding on one of the butting engines. As committing murder is not the privilege of state fair committees, the application of the Canadian had to be refused, although he alleged that riding on locomotives had been his lifework and that it was only fair that he should be permitted to finish in heroic style.

About Sweet Flag.

The sweet smelling calamus which grows in many American swamps is said to be the same plant that grows on the Nile, the same plant that waved above Moses in the bulrushes. It is the sweet flag. A writer in the *Chicago Post*, telling of these things, says that mints, bergamot, southern wood, ambrosia, wild thyme and marjoram are other plants to be found in ordinary swamp land. The word calamus means a reed in Latin, and hence a pipe, a pen, an arrow or a rod.

The Optics of a Railway Signal Lamp

Years ago it came to the knowledge of our chief editor that Mr. T. A. Lawes, now mechanical engineer of the New York, Chicago & St. Louis Raliways, had devoted much attention to the testing of lamp lenses, and that he had become an expert on that class of work. At the urgent request of the writer, the following article was obtainable from Mr. Lawes:

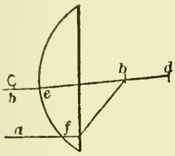


Fig. 1


Fig. 2

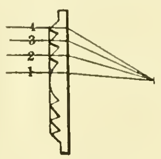


Fig. 3


Fig. 4

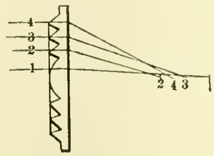


Fig. 5


Fig. 6

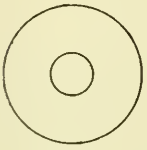


Fig. 7

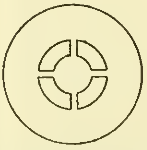


Fig. 8

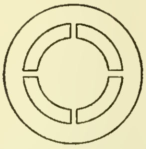


Fig. 9

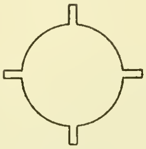


Fig. 10

Fig. 11

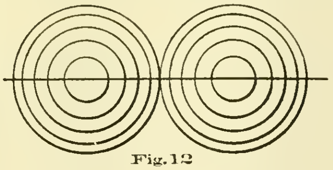


Fig. 12

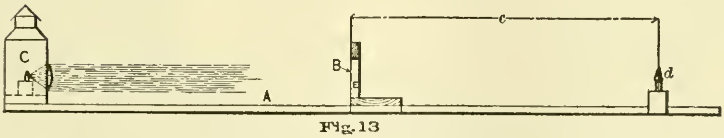


Fig. 13

THE OPTICS OF A RAILWAY SIGNAL LAMP.

SPHERICAL ABERRATION.

The forms of lenses in common use in signal lamps are shown in Figs. 1, 2, 3, 4, 5 and 6. Fig. 1 is a lens now seldom seen in railway practice, being supplanted by others more perfect in form and lighter in material. The law for the survival of the fittest here prevails, as in the animal or vegetable kingdoms.

Figure 1 is deficient in this particular: Parallel rays of light nearest the axis of the lens are refracted to a focus more remote from the lens than those which are incident at a distance from the axis of the lens.

In this lens, either by experiment or projection of the rays of light, the ray A will meet the axis at B and the ray A at D. The distance B D is called the spherical aberration, and in this form will amount 1 17/100 of the thickness of the lens. As the central parts of the lens refract the light too little and the outer parts too much, it is clear, if we should increase the convexity at E, and decrease it at F, we should remove the spherical aberration. The ellipse and hyperbola are curves of this kind in which the curvature decreases from E to F, but while a lens of this form is perfect, yet the great difficulty of making these curves has prevented its introduction. Corrugated lenses, invented by Fresnel, are the forms in general use, and in comparison

with the plano-convex, can be made much lighter, and the spherical aberration corrected by making the foci of each zone coincide, as in Fig. 3, in which the rays of light coming from the focus are refracted into parallel lines; and by the law of congugate foci, the reverse holds true, namely, light falling on the lens in parallel lines is refracted to a focus. To determine experimentally if a light falling on a certain lens was refracted to a focus free from spherical aberration, a series of opaque diaphragms were used, so arranged that zones 1, 2, 3, 4, Fig. 3, could be tested separately. The diaphragms were made from a thick piece of drawing paper, on the plan shown in Figs. 7, 8, 9 and 10.

For measuring the aberration of the lenses, an instrument was devised, shown in Fig. 11. This was made very simply, and the material was pine wood. The face A is covered with white paper, B is a sliding piece carrying the lens to be tested. The method of testing is this: The lens is held on B by three wooden clamps, and a diaphragm, Fig. 7, placed on the lens, stopping off all the light except the central ring 1. The instrument is turned to the sun, and the sliding piece moved to and fro until a clear image is obtained. The distance D is noted: the diaphragm, Fig 7, is removed, and Fig. 8 put in its place and tested, the distance D is noted, and so on, until all the zones are tried. Fig. 5 shows the aberration of a certain lens as found by this instrument.

PURITY OF THE GLASS.

The comparative purity can be tested by observing the appearance of a black line upon white paper, when the lenses to be compared are laid upon it. The lens that shows the darkest line is the one made from the purest glass. Care should be used in this test, that the edge of lenses only be used, as they have parallel sides for a short distance. This can be done, and any error arising from the different curvatures be avoided. Fig. 12 shows the position of the lenses in regard to the black line.

PHOTOMETRIC TESTS.

In my first photometric experiment, the method of comparative shadows was used as devised by Rumford, but was finally abandoned in favor of a photometer invented by Bunsen. Rumford's photometer on account of the different sizes of shadows, makes it difficult to decide when they are of equal intensity. Bunsen's being used on a different theory, practically easy to manipulate, and at the same time accurate, led to its adoption over other forms of photometers in use. My photometer was made of pine wood. See Fig. 13. The strip A is ten feet long. B is a paper screen on a sliding piece of wood. C is a lamp so arranged that lenses can be introduced quickly. D is a sperm candle used in these experiments as a standard of comparison. The paper screen is glued upon the sliding piece while wet; when dry, it becomes tight like a drumhead. The aperture in E, over which the paper screen is placed, is 8 inches in diameter; in the center of the screen a grease spot is made about ½ inch in diameter.

This is best made with spermaceti dissolved in naphtha. The theory of the spot is this: The spot allows more light to pass through it, and consequently reflects less than the unstained part of the paper: if, therefore, the paper be illuminated more strongly from behind, it appears bright on a dark ground. On the other hand, it appears dark on a white ground if it be more strongly illuminated on the front surface; while with equal illumination the spot becomes invisible, since it cannot then appear either darker or lighter than the adjoining paper. The lenses are tested by moving the candle until the grease spot disappears. The distance E is noted for each lens under consideration. They are to be compared with each other inversely as the square of the distance E.

The apparatus used by me in testing did not cost over $3, being made principally from pine wood, utilizing an old switch target lamp to hold the lenses in the photometric tests. While the cost is but small, the satisfaction is great. Where uncertainty before existed, no obstinate doubt remains after such tests.

RESULTS.

1. It has been found by means of these tests that lenses from the same makers often vary 7 per cent. in their transmitting power, although to the eye they appear apparently similar.

2. Lenses by different makers vary as much as 50 per cent. in light transmission.

3. Certain lenses were so deficient that the outer zone could be stopped out, and the quantity of parallel light transmitted would not be affected thereby.

4. A removal of the flame ½ inch from the focus reduced the light in one instance 20 per cent.

Always have the flame in the focus, if the best results are wished for.

Sun-Power Engine.

An interesting report concerning irrigation by sun power is made by the British consul at Alexandria, who comments on the arrival from Philadelphia of the Shuman sun-heat absorber, which, he says, was tested and found to be satisfactory. The plant is being erected at Meadi, near Cairo, and will be used to pump water from the Nile to irrigate the surrounding land. Several improvements have been added to reduce the cost of working. In Egypt both coal and other kinds of fuel are expensive, says the consul, but plenty of sunshine can be relied upon at all times of the year, so that the experiments with this practical sun-power plant will be of much interest to agricultural enterprise.

Ignominy and Glory of Texas.

There has lately been a movement among the people of Texas to secure more railroad accommodation, as they have come to realize that the immense resources of the State are wasted for want of the means of transporting them to markets. Years ago, when railroad builders were extending lines into every territory likely to give moderate returns on the investments, a considerable mileage of railroads was extended into Texas, but that good was little more than started than the goose ready to lay the golden egg was killed.

About 1890 an anti-railroad crusade was started in Texas, and for years the principal labors performed by the individuals elected by the people of Texas to legislate for the benefit of the State devoted themselves to working out legal methods of robbing the owners of railroad property. The railroads in Texas had been built almost exclusively with foreign capital. On this account it was easy to incite legislators to act as if this species of property had no rights which Texas people were bound to respect. The policy adopted was shortsighted even when viewed from a Texas standpoint, for men with capital ready to invest in railroads or other public utilities began keeping severely away from the State, with the result that railroad building ceased and has kept suspended. That natural result of bad treatment left a splendid field of potential industry undeveloped, deprived thousands of people from enjoying lucrative employment and comfortable homes, and left fruitless vast regions capable of yielding rich harvests.

When people look casually at the map of the United States they generally notice that Texas is a very large State; but few of them realize that the State of Texas is as large as New York, New Jersey, Delaware, Maryland, Pennsylvania, Ohio and Indiana combined. Yet its size is only one of its striking characteristics. It has more coal lands area than Pennsylvania, more iron than Alabama, more granite than New Hampshire, more pine than Wisconsin, more oak than West Virginia, more prairie than Kansas, more corn land than Illinois, more wheat land than the two Dakotas, more cotton land than Mississippi, more sugar land than Louisiana and more rice land than South Carolina. It contains more mines than any other five States, has 14,000 miles of railroad and has room for 10,000 miles more.

Type of Mallet Locomotives for the Great Northern Railway

It is interesting to observe the continued development of the Mallett type of locomotive, and considerable attention is attracted to the completion by the Baldwin Locomotive Works of 25 new Mallets of the 2-8-8-0 type for the Great Northern Railway. These powerful locomotives develop a tractive force of 100,000 pounds working compound. This represents an increase of 36 per cent. over the locomotives of the 2-6-8-0 type built for this road in 1909, and of 55 per cent. over the original 2-6-6-2 type locomotives built in 1906. Seventeen of the new locomotives use coal as fuel, while the remaining eight are oil burners. All are arranged for the use of highly superheated steam.

The boiler is of the Belpaire type, 90 inches in diameter at the first ring and 102 inches at the dome ring. The tubes are 24 feet long. The firebox has a combustion chamber 58 inches long. This chamber is flattened on the under side, so that the water space beneath it has a depth of 9⅝ inches, giving a free entry to the throat. Expansion bolts are used on the crown, and flexible bolts on the sides and bottom. The main dome is formed of a single piece of flanged steel, and is 10½ inches in height by 33 inches in diameter. The safety valves and whistle are mounted on a steel casting and depressed into a circular opening 26 inches in diameter. This recess is cut into the boiler behind the dome. A firebrick wall is built across the throat of the combustion chamber.

The superheater is of the Emerson type, and the pipe connecting the high and low pressure cylinders embodies some new details in construction. The center line of the ball joint at the back end of the pipe coincides with the center of the articulated frame connection, so that the length of the pipe remains constant when the engine is traversing curves. The ball joint is placed in a cavity formed in the high pressure cylinder saddle. The ball is a steel casting, which is screwed and acetylene welded to the pipe, and is seated on two babbitt lined rings of brass. These are held in place by a packed gland. At its forward end, the receiver pipe is slip jointed to a cast steel Y connection, one branch of which leads to each low pressure steam chest.

The steam distribution to all the cylinders is controlled by inside admission piston valves, which are of the built-up type, 15 inches in diameter. The high pressure valves are of the usual design, while the low pressure valves are arranged for double admission, thus giving ample port openings. The high-pressure valves have ¼-inch lead, and the low pressure ⅜-inch lead. The valve gears are of the Walschaerts type, and they are controlled by the Ragonnet power mechanism. A special feature on these engines is an arrangement for varying the cut-off in the low pressure cylinders independently of the high pressure. The high pressure reverse shaft has bolted to it a downwardly extending slotted arm. A block is fitted in this slot, and to the block the reach rod is pinned. The block can be raised or lowered by a lift shaft, which is rotated by means of a screw and hand wheel placed in the cab. The lift shaft is of cast steel, made in halves; and it is mounted directly on the reverse shaft. By raising the block in the slot the low pressure reverse shaft is rotated and the cut-off in the low pressure cylinders shortened. When the high pressure engine is in full gear, the cut-off in the low pressure cylinders can be reduced, with this device, by as much as 20 per cent. The cut-offs in the two engines can thus be adjusted to give the most equal division of power when running at various speeds.

Restricted clearance limits make it difficult to place sand boxes on top of the boiler, and a supply of sand is carried in two boxes, which are placed over the forward deck plate. Sand is delivered in front of the leading driving wheels only. The bell is placed on the left-hand side, on the round of the boiler.

The following are the principal dimensions of this type of locomotive:

Gauge, 4 ft. 8½ ins.; cylinders, 28 ins. and 42 x 32 ins. Valves, balanced piston.

Boiler.—Type, Belpaire, conical; material, steel; diameter, 90 ins.; thickness of sheets, 15/16 in. and 1 in.; working pressure, 210 lbs.; fuel, soft coal; staying, radial.

Firebox.—Material, steel; length, 117¼ ins.; width, 96¼ ins.; depth, front, 87¼ ins.; depth, back, 76¼ ins.; thickness of sheets, sides, ⅜ in.; thickness of sheets, back, ⅜ in.; thickness of sheets, crown, ⅜ in.; thickness of sheets, tube, ⅜ in.

Water space.—Front, 6 ins.; sides, 5 ins.; back, 5 ins.

Tubes.—Diameter, 5½ and 2¼ ins.; material, steel; thickness, 5½ ins., No. 8 W. G.; thickness, 2¼ ins., No. 11 W. G.; number, 5½ ins., 42; 2¼ ins., 332; length, 24 ft.

Heating surface.—Firebox, 245 sq. ft.; combustion chamber, 81 sq. ft.; tubes, 6,120 sq. ft.; total, 6,446 sq. ft.; grate area, 78.4 sq. ft.

Driving wheels.—Diameter, outside, 63 ins.; diameter, center, 56 ins.; journals, main, 11 x 12 ins.; journals, others, 10 x 12 ins.

Engine truck wheels.—Diameter, 33½ ins.; journals, 6 ins. x 12 ins.

Wheel base.—Driving, 43 ft. 3 ins.; rigid, 16 ft. 6 ins.; total engine, 52 ft. 6 ins.; total engine and tender, 83 ft. 1 in.

Weight, estimated.—On driving wheels, 420,000 lbs.; on truck, front, 30,000 lbs.; total engine, 450,000 lbs.; total engine and tender, 600,000 lbs.

Tender.—Wheels, number, 8; wheels, diameter, 36 ins.; journals, 5½ x 10 ins.; tank capacity, 8,000 gals.; fuel, 13 tons; service, freight.

2-8-8-0 TYPE OF MALLET LOCOMOTIVES FOR THE GREAT NORTHERN RAILWAY.
R. D. Hawkins, Superintendent of Motive Power. Baldwin Locomotive Works, Builders.

Ten-Wheel Locomotives in Great Britain

The North Eastern Railway of England has recently built at the Darlington works of the company, ten locomotives of the ten-wheel type. They are from designs of Mr. Vincent Raven, Chief Mechanical Engineer. They are fitted with Schmidt superheaters, and the reports already at hand are highly favorable to this type of locomotive. As shown in the accompanying illustration the structure is of the most compact and substantial kind, and on the finely laid British tracks, the running is said to be of the smoothest kind. The leading dimensions are as follows:

Cylinders, 20 ins. diameter; 26 ins. stroke, with piston valves; coupled wheels, 6 ft. 1¼ ins. diameter; truck wheels, 3 ft. 7¼ ins. diameter; boiler, 15 ft. long, 5 ft. 6 ins. diameter; firebox, 8 ft. long outside; heating surface; small tubes, 1,173 sq. ft.; superheater tubes, 504 sq. ft.; firebox, 144 sq. ft.; total, 1,821 sq. ft.; fire grate area, 23 sq. ft.; capacity of tender tanks, 3,940 gallons; coal space, 5 tons; tender fitted with water pick-up; total weight of engine in working order, 68 tons, 17 cwt.; total weight of tender in working order, 41 tons, 2 cwt.; total, 109 tons, 19 cwt.

TYPE OF TEN-WHEELERS FOR THE NORTH EASTERN RAILWAY OF ENGLAND.

British Railwaymen's Improved Pay.

The government's railway conciliation scheme, which stopped the strike, has now worked out in the concrete form of substantial increases of pay to the men on three systems. On the chief of them, the Lancashire & Yorkshire, nearly half the signalmen get 1s. 6d. (36½ cents) a week advance, and the other half 2s. 6d. (61 cents) a week, amounting altogether to about $50,000 a year. The engine drivers and other locomotive men get increases which will total $50,000 or $60,000 a year. Platform porters are to get 20s. ($4.87) a week, which is 1s. (24⅓ cents) and 2s. (49 cents) a week more than they have been getting since the strike, and 3s. (73 cents) a week more than they got before the strike. In the same way passenger guards, who before the strike seldom got more than 28s. ($6.81) a week, are now given a maximum of 32s. ($7.78), to be reached automatically after seven years' service These are not princely salaries, of course, but it may be said that they are fair pay as workmen's wages go in Great Britain, especially so long as they are combined with superannuation, with the widest opportunities of promotion, and with security of tenure.

A British Railway Accident.

British railways are remarkably free from serious accidents, considering that many trains are run at very high speeds, the rarity of accidents being primarily due to the rigid adherence to the rules manifested by train men. A serious accident happened, however, on the London & Northwestern in Lancashire on September 17, when 14 people were killed and about 50 seriously injured.

While going down a steep grade the engine of an express train jumped the track and hit the buttress of a bridge which spanned the road at this point. There was a terrific crash like an explosion, and seven of the nine cars followed the engine. Every passenger in the first two cars was killed. The last two cars remained on the track and the passengers in these coaches were not seriously injured. The other seven cars turned over and caught fire.

There was plenty of help at hand, but the flames prevented the immediate rescue of the penned-in passengers and some were roasted to death in sight of the onlookers.

Rolling Stock on Railways in India.

During 1911 the additions made to the rolling stock of Indian railways consisted of 222 locomotives, 1,039 passenger cars and 3,485 freight cars. Since the first of the year the purchase of 34 locomotives, 199 passenger cars and 1,044 freight cars has been authorized. During 1911, 435 locomotives, 1,131 passenger cars and 8,002 freight cars were fitted with automatic brakes, bringing the total number so equipped at the close of the year up to 5,713 locomotives, 17,462 passenger cars and 56,721 freight cars. This compares with 1,702 locomotives, 3,944 passenger cars and 94,608 freight cars not equipped with automatic brakes. In the same year 1,324 passenger cars were fitted for gas or electricity, making the total number so fitted at the close of the year 17,415, compared with 4,317 not fitted. The number fitted for gas was 376, and for electricity, 948.

Modern Palestine.

It is no longer a surprise to the visitor to Palestine to find Jerusalem a city of modern conveniences and western civilization. Even the structures of the ancient city have changed. Where once were crumbling walls and ancient temples are now blocks of government buildings; on the site of the Jaffa gate is a broad and imposing avenue. In the streets are tramways and taxicabs, and the western water-cart has supplanted the Jew with his goatskin of water.

Of late years, and owing to the progressive policy of the Young Turk government in Constantinople, the spirit of modernity has invaded the countryside. In the plains of Sharon and on the tablelands between Jaffa and Jerusalem, steam-driven threshing machines and self-binding reapers are at work. Water is supplied by means of pumps driven by motors, Abraham's well at Beersheba being pumped in this fashion. Up-to-date motor boats now cross the sea of Galilee, and a scheme is under consideration whereby similar boats will ply the River Jordan. Damascus, the oldest city in the world, is now being equipped with tramways and an electric lighting plant, and a spirit of twentieth century progress seems to be abroad in the land.

General Foremen's Department

Repairing Injectors.

The repairing of an injector should only be given to experienced hands, and as no one can gather experience without opportunity the experienced man should have an assistant or learner who under the eye of the master should be able in the course of time to graduate as an expert in injector work. A thorough knewledge of the injector and check is an essential requisite, and the principles involved in the action of the injector, which are not altogether free from the realm of discussion and difference of opinion, should be studied and, if possible, mastered. Not every machinist is qualified by nature to handle the injector. It requires a delicate hand—a mathematical precision, a watchmaker's exactness, a pipefitter's knowledge of the pressure that tubular work will safely bear—all essential requisites to the mechanic entrusted with the repair of injectors.

Like all engineering work it is something where theory and practice—thought and action—test the higher capabilities of the skilled workman. As a rule the reports in regard to the condition of the injector when in need of repairs are of the vaguest kind. "Injector not working," is the stereotyped report. It is safe to proceed to take out the main valve, or ram, and primer cock, the water valve, and the frost plug, and then take the injector entirely apart, and remove the nozzle. Clean all sediment out of the shell, and soak the shell in benzine and see that all scale is removed from the inside of the shell. The nozzles should also be carefully examined and cleaned. If they show indications of wear and are consequently larger than the standard size, they may be set down as having served their day. It should be remembered that no kind of mechanism subjected to varying temperatures and pressures will last very long, and in the case of the injectors the relation of the parts to each other are the result of much experiment and a departure from the standard size of one part destroys the action of the whole.

If the injector is divided, as it usually is, into two or three parts, each joint must be perfectly tight and on being put together, oil or white lead or varnish should be used in tightening so that the possibility of leakage by variation in the density of the metal, or tool marks, may be avoided. If valves or valve seats show marks of wear, they should be refitted, or replaced, as the condition may warrant. In refacing a valve seat, a bushing should be used to keep the rosebit central. The fitting of valves to valve seats is a delicate operation, and the use of flour or fine emery, ground glass and oil, and other fine abrading substances are matters of choice about which it would hardly be safe to venture an opinion. Like the artist who when he was asked how he mixed his colors replied briefly that it was with brains.

It need hardly be stated that all threads should be examined and, if packing nuts, or other unions, are loosely fitting they are worse than useless, and should be replaced. All stems should be re-packed with asbestos. It is preferable to lamp wick or other readily destructible material. If all joints are tight at the final test, the injector will in all likelihood work satisfactorily for a time, but it will not work forever. It may be added that when taking an injector apart if some joint is refractory it is good practice to warm the part when it will readily loosen. Brass is easily expanded.

As we have frequently stated in answer to questions regarding injector troubles, sometimes the trouble is not with the injector at all. Hose and especially suction pipes should be carefully examined and if the slightest leak occurs in these connections. the perfect working of the best injector becomes a physical impossibility.

Dirty Shops.

You do not act up to the principle that "cleanliness is next to godliness," we remarked to a master car builder, as we stumbled with him to and fro about an establishment that was macadamized with fragments of timber, bricks, greasy waste, worn out air hose, tatters of cushions, broken bolts, old brake shoes, dilapidated axle boxes, lumps of broken wheels and no end of other litter. "The company is too poor to employ men to clean up the place," was the answer, and it looked to the writer as if the condition of that shop alone was enough to help the company rapidly toward the hands of a receiver.

When we see an establishment remarkable for its untidiness and squalor, we are always sorry for the man in charge because the place is bearing testimony to his incompetency. Where shops and their surroundings are strewn with litter that ought to be converted into some useful purpose, instead of obstructing the operations of workmen, it may safely be concluded that the whole establishment is in the condition of confusion. "A place for everything and everything in its place," is the condition under which all successful shops are run. The finding of places for everything and seeing that they are kept there, is an essential element in the makeup of a good foreman or manager. When this practice is not followed we find workmen searching all around the shop for tools and mining through strata of rubbish for bolts or some article wanted which has no established resting place. The loss of time that results from this unorderly way of running a shop largely increases the cost of work and would often pay the cost of cleaning up ten times over.

Another objection to squalor in and around a shop is that it seems to demoralize the workmen. There is a listless, lazy air about such a place that imparts itself to most of the men coming within its influence. If you stand and watch the men in a clean, orderly shop, you will notice that all hands are active and all minds devoted to the work on hand. There is vigor and energy in every movement. In the dirty shops the reverse picture prevails. Filth seems to dissipate the magnetism which spurs men to exertion. It is not hard to understand why men in charge of shops run on the never-pick-up-anything plan come to imagine that the company is too poor to bear the expense of cleaning up. The first operation in reform ought to be on the man in charge.

Dr. Diesel on the Diesel Engine.

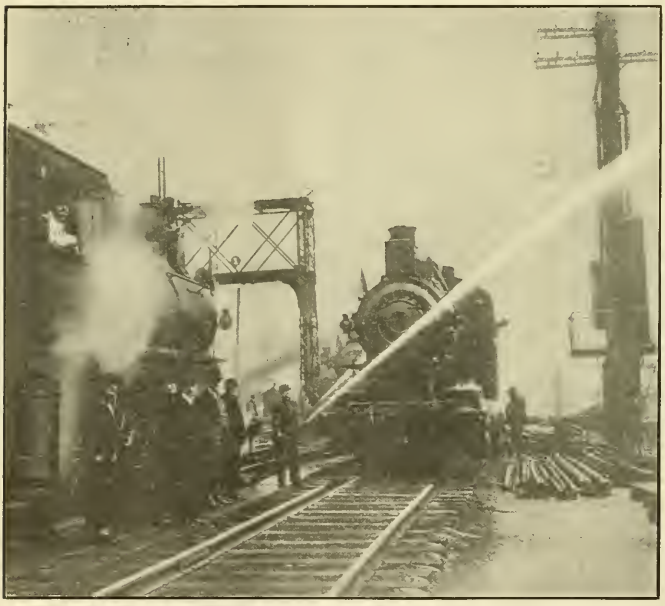
Dr. Rudolph Diesel, in his recent trip to America said that the Diesel engine is the only engine which converts the heat of the natural fuel into work in the cylinder itself without any previous transforming process, and which utilizes it as completely as the present advancement of science permits. The term "semi-Diesel" has, however, come to be applied to engines using heavy fuel oils and operating in a general way on the Diesel principle. Most of these "semi-Diesel" types are different from the Diesel engine in the manner in which the air is compressed and drawn into the cylinder and in the manner of injection of the fuel. It will be noted that there is a large amount of misconception about what the Diesel type really is. A textbook on gas engines that is considered very reliable refers to the Diesel purely as a four-cycle engine, whereas it is built also in two-cycle units. "Semi-Diesel," therefore, is not a well defined term.

It may be added that as Dr. Diesel is still improving his engine the definite and finished form of his invention is not yet in operation.

Pennsylvania Switchers as Fire Fighters.

It may not be generally known even among railroad men that for several years the Pennsylvania Railroad has been equipping a considerable number of switching locomotives with fire extinguishing apparatus, and so successful has the introduction of the locomotive as a fire engine been, that in less than four years no fewer than 153 fires on Pennsylvania railroad property have been extinguished by them.

As will be noted in the accompanying illustration, there is a cylindrical shaped tank placed under the cab. This is adapted for holding a sufficient supply of hose to reach intervening distances that may happen to lie between the available track and the scene of the fire. At first the apparatus used consisted of a hose connection placed in the line conveying water from the injector in the engine cab to the boiler. This has been improved upon by providing a special form of extinguisher, by which the water from the locomotive tender is discharged through an ejector by means of the high steam pressures carried in locomotive boilers. Based on a series of tests, the standard equipment for each locomotive consists of one hundred and fifty feet of two and one-half inch unlined linen hose and a fifteen-inch cast-iron nozzle with a discharge opening of five-eighths of an inch, kept in a box under the running board of the engine—the hose being coiled in separate sections. With this equipment engines are enabled to throw a stream of water a distance of about seventy feet.



PENNSYLVANIA SWITCHERS AS FIRE FIGHTERS.

The Yards are divided into districts each of which is designated by a number. When a fire is discovered a general alarm calling all engines in the particular district is sounded on air whistles installed on each switch tower. By a code of signals engineers and firemen of locomotives can tell immediately just where the fire is. To insure a prompt response Yard Masters and Train Directors are instructed to give the locomotives clear track in reaching the scene of fire, and in cases where locomotives are moving or shifting cars, the crews are instructed to uncouple the engines and proceed without delay to the fire immediately upon sounding of the alarm, on the way to the fire connecting up the hose and preparing to get into service immediately upon arrival.

The locomotive fire brigade organization in each Yard is under the general supervision of the Assistant Yard Master acting as Chief and co-operates at all fires with the regular Yard Fire Brigade, which is organized and regularly drilled at each point. The conductor of the shifting crews is designated as Captain and has direct charge of his own crew in all fire operations. To each member of the crew is assigned a special duty—to the flagman the unreeling and laying of hose line and making connections; to the two brakemen the moving of the hose line and directing the nozzle; the engineer and firemen, the operation of the pump and maintaining the required pressure.

One of the great advantages in having these fire equipped locomotives is the fact that they are always "on the ground" ready for immediate service and affording protection for Yards, which, in many instances, would not be accessible to outside Fire Departments. By careful supervision and frequent drilling the crews become expert in fire fighting—an example of the efficiency of these organizations is shown in response to a fire exposing a gas tank under a passenger car; here the first engine was coupled up ready for service within two minutes after the sounding of the alarm, while within seven minutes nine engines were on the scene.

Last year the record showed that these locomotives extinguished 49 fires, and all of them with a degree of promptitude that would serve as an excellent object lesson to the best drilled fire brigades. At the present time the locomotives equipped for fire-fighting service are divided as follows on the lines east of Pittsburgh and Erie: New Jersey Division, 216; Eastern Pennsylvania Division, 110; Western Pennsylvania Division, 131; Northern Division, 17; Erie Division and Northern Central Railway, 35; Philadelphia, Baltimore & Washington Railroad, 30; and Philadelphia Terminal Division. The extension of the fire-fighting locomotives to new sections of the great railroad in the near future may be confidently looked for.

Improved Method of Lifting Pig Iron with a Magnet.

It is quite a common practice to use lifting magnets for handling furnace pig iron. Usually the pigs are stacked horizontally and not many of them can be lifted at a time because a relatively small number can be brought into contact with the magnet. Someone has recently hit upon the idea of stacking the pigs vertically, so that the face of the magnet will touch a greater number of pigs. It has been found that by this method, the lifting capacity of a magnet which heretofore was able to raise only 1,000 lbs. of pig iron was increased to 2,000 lbs.

To Make Oil Paint Stick.

To make oil paint adhere to cement the surface of the material should be coated with diluted sulphuric acid (1 part concentrated acid to 100 parts of water), which afterwards must be washed off and the surface allowed to dry. Or the surface may be covered with diluted silicate of soda (wasserglas), the solution to be 1 to 3 or 1 to 4, and applied three times in succession. Still another method is to apply two coats of building "fluat" at least 24 hours apart. Practical builders, state, however, that the applications of sulphuric acid are not made by them, and that such success as they have results merely from careful work and the use of good materials.

Questions Answered

CAUSES OF SMOKING.

205. W. H., Philadelphia, Pa., asks: (1) What will cause an engine to smoke with the blower in good condition and working properly?—A. While a blower in thorough operation creates a vacuum and induces combustion, it does not prevent smoke which may arise from a number of causes, among which are the clogging of the grates, irregular firing, defective draft appliances, and leaks in front end or base of smokestack, improper use of fire tools, and poor coal or poor condition of good coal. The kind of firebox and the kind of work to be done are all factors in the art of firing, to which the action of the blower is merely a contributing part and not a controlling factor. (2) What effect will a stopped-up netting in front end have? Does it cause an engine to smoke badly with the blower in good condition?—A. It has the effect of preventing rapid and proper combustion, and thereby induces or creates a continuance of smoking. The area of the openings in the netting should at least equal the entire area of the smokestack Anything less hinders combustion and increases the tendency to smoking, and lessens the steaming qualities of the engine As the netting has a tendency to become stopped at some parts more than at others, the effect on the fire is also variable at different places, and the firing, however careful, cannot overcome the defect of a clogged netting.

DEFECTIVE HANCOCK INSPIRATOR.

206. A. E. C., Clarion, Iowa, asks: Please answer through the columns of Railway and Locomotive Engineering what effect a leaky intermediate overflow valve would have with the working of a Hancock Inspirator?—A. It would have the effect of reducing the quantity of water delivered by the inspirator, as a leaky intermediate overflow valve would act as a by-pass, that is, working the water over and over again and consequently reducing the quantity delivered, and at the same time would increase the temperature of the water delivered very materially. Of course, the leak would have to be quite pronounced to affect the quantity delivered to any appreciable extent.

FLUES AND IDLER BRASSES.

207. P. E. W., Villupuram, S. India, asks: (1) When a tube bursts which end should be plugged first?—A. The firebox end. (2) On page 237 of your July issue is shown a device for turning Idler brasses. For the benefit of your foreign readers will you please explain what an idler brass is?—A. An idler brass, is used on the Pacific type (4-6-2) locomotives only. In counting the wheels from the front or smoke box end, the sixth wheel is the idler, or wheel below the firebox. For that particular axle there is a special box required, and the brass is about one and a half times longer than the brasses on the front truck or tender truck, and when the brass is being machined in the machine shop it is not so easy of handling, unless with special appliances. It is fitted with considerable lateral motion to admit of the swing of the rear end of the locomotive in curving.

SHAY GEARED LOCOMOTIVE.

208. A. M. Engineer, writes: Please tell me through your magazine how to figure the tractive power of a Shay geared locomotive. A. In calculating the tractive power of a Shay Geared Locomotive the following formula is used:

$$T = \frac{d^2 \times S \times G \times 1.5 \times .75P}{D}$$

Where T =Tractive force in pounds.
d =diameter of cylinders, in inches.
S =stroke of piston, in inches.
G =Ratio of Gearing.
1.5 =Multiple to account for the third cylinder.
.75P =75 per cent. of the boiler pressure which is assumed to be the effective pressure of the steam in cylinders.

Example—Find the tractive power of a Shay locomotive, having three cylinders 10 inches in diameter, 10 inches stroke, 180 lb. boiler pressure gear ratio 2.05 driving wheels 28 inches diameter.

$$\frac{10^2 \times 10 \times 2.05 \times 1.5 \times (.75 \times 180)}{28} = 14825 \text{ lbs.}$$

The result is obtained by squaring the diameter of the cylinders, in inches, multiplied by the stroke, in inches, multiplied by the gear ratio, multiplied by 1.5, multiplied by 75 per cent. of the boiler pressure and divided by the diameter of the drivers in inches, thus:

$10 \times 10 = 100 \times 10 = 1000$
$1000 \times 2.05 = 2050$
$2050 \times 1.5 = 3075$
$3075 \times 135 = 415125$
$415125 \div 28 = 14825$ lbs.

The same method is used to calculate the tractive power of the two cylinder Shay Locomotives, except the multiple 1.5 is omitted.

WEBB COMPOUND.

209. J. F. K., Trenton, N. J., asks: In the Webb three-cylinder compound locomotive how many exhausts are there for one revolution of the driving wheel?—A. Two.

RETAINING THER TENDER BRAKE.

210. A. B., Youngstown, Ohio, writes: A number of engineers are of the opinion that the E. T. locomotive brake is not entirely satisfactory when descending long, heavy grades with a lone engine, that is, there should be some means of releasing the engine brake while the tender brake should remain applied. Could the E. T. equipment be arranged in a manner to permit of this feature?—A. Yes. Releasing the engine brake while the tender brake remains applied is made possible by the use of a triple valve and auxiliary reservoir on the tender, but if only the retaining feature of the tender brake cylinder is desired it can be secured by changing the tender brake cylinder pipe to pass through the cab, then if the cut-out-cock is located within easy reach of the engineer, he can, after an application and just before releasing, close the cock, which will then retain the pressure in the tender brake cylinder. During each application the cock could be opened to replenish the cylinder, but you will, however, understand that we could not recommend a continuous braking effect on a tender when descending long grades.

OPERATING PIPE CONNECTION.

211. K. N., Wheeling, W. Va., writes: I recently saw an engine with the E. T. brake on which the lower pipe connection of excess pressure head of the governor was connected with the governor pipe to the maximum top and the governor operated just the same as though the connection was made with the brake valve. Is this excess pressure operating pipe unnecessary?—A. Inasmuch as there is a flow of air from the main reservoir through the brake valve rotary to the upper side of the diaphragms of the excess pressure head when the brake valve handle is placed in lap position, this change does not affect the operation of the governor.

This method of connecting the governor top is not a very recent discovery and while it is satisfactory, we prefer the excess pressure operating pipe not only because a closed or broken governor pipe would then render inoperative both governor tops, but in the event of a diaphragm valve sticking open or a piece of dirt lodging on the valve or seat of the excess pressure head, might, because of a constant main reservoir pressure under the diaphragms, hold the steam valve closed and result in a detention while if the connections are made according to specifications a disorder of this kind can be located and the pump kept in action by alternating the brake valve handle between running and lap positions until such time as the operating pipe can be disconnected near the brake valve; thereafter the escape of air can be stopped with a wooden plug.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances.

Published Monthly by

ANGUS SINCLAIR CO.

114 Liberty Street, New York.

Telephone, 746 Rector.
Cable Address, "Locong," N. Y.
Glasgow, "Locoauto."

Business Department:

ANGUS SINCLAIR, D. E., Prest. and Treas.
JAMES KENNEDY, Vice-Prest.
HARRY A. KENNEY, Secy. and Gen. Mgr.

Editorial Department:

ANGUS SINCLAIR, D. E., Editor.
JAMES KENNEDY, Managing Editor.
ALLEN G. WOOD, Consulting Engineer.
GEO. W. KIEHM, Associate Editor.
A. J. MANSON, Associate Editor.

Boston Representative:

S. I. CARPENTER, 643 Old South Building, Boston, Mass.

London Representative:

THE LOCOMOTIVE PUBLISHING CO., Ltd., 3 Amen Corner, Paternoster Row, London, E.C.

Glasgow Representative:

A. F. SINCLAIR, 15 Manor Road, Bellahouston, Glasgow.

SUBSCRIPTION PRICE

$2.00 *per year,* $1.00 *for six months, postage paid in the United States, Canada and Mexico. For other parts of the world,* $2.50, *or ten shillings. Single copies, 20 cents. Remit by Express Money Order, Draft, Post Office Order or Registered Letter.*

Mailing address can be changed as often as necessary—always give old and new address, and if you subscribe in a club, state the name of the agent.

Please give prompt notice when your paper fails to reach you regularly.

Entered at the Post Office, New York, as Second-class Mail Matter.

Work and Wages.

While the principal aim of every railway company, as a legitimate business enterprise, is to make returns upon its investment, it may with propriety be asserted that the first and greatest responsibility resting upon those in charge of its practical operation, is that of safety; and a large part of railway earnings must, in fulfillment of this obligation, be expended in improvement and maintenance of the property sufficient to insure, as far as possible, safety to life, not only of the public, but particularly of its employees.

Those who have worked on railroads where the pay car moved over the road at irregular intervals, realize that it is highly important that there should be sufficient earnings to make fair and prompt compensation of the employees. This is highly important, not only to the people working for railways, but also to the general public who depend upon the vast army of railway men for the circulation of money that keeps up an active condition of prosperity all round.

There is no feature of progress more exceptional to this age than the advancement in the condition of and the recognition afforded those who live by toil; and it is safe to assert that no commercial agency or interest has done more to recognize the worth and merit of those engaged in manual employment, or to improve and advance their condition, in the scale of compensation given out, in self improvement and in standing in society at large than the railway companies. There have been some exceptions, but the men managing our railways have generally been fair to those forming the ranks of labor from which they rose. They recognize that prosperity is the product of labor. It must be hewed out of the forest, plowed out of the field, blasted out of the mines, pounded out of the anvil, wrought out of the factory, the furnace and the machine shop. But honest labor is at the bottom of it all, and the conditions that tend to make labor satisfied are those that promote prosperity in the highest degree.

Inventors and Railroad Men.

Bitter complaints are often heard expressed by inventors, about the apathy of railroad companies regarding inventions that have been devised for the purpose of improving railroad appliances, or for providing the means of operating trains in a safer and cheaper manner. They say that when an invention is produced calculated to improve the machinery employed by private individuals or ordinary companies, there is no difficulty experienced in obtaining an opportunity to test the value of the invention; but that when anything of the kind is brought out applicable to railway machinery, the inventor, in trying to get it applied, is referred from one officer to another, and is often subjected, to tiresome delays, uncivil rebuffs and general contemptuous treatment. In many cases these complaints may be well founded, but inventors are by no means the only aggrieved parties in the premises.

Inventions intended for railroad purposes are often difficult and expensive to apply and require skillful supervision to test properly. In many instances they are troublesome to operate and even dangerous; yet the inventor never thinks these drawbacks should prevent a railroad company from trying a device which he alone conceives to be an improvement. But the great trouble is, that a multitude of inventors are yearly rejuvenating ancient devices that have been found worthless many years ago, and which are perfectly familiar to the men of experience in charge of railroad mechanical departments. An ingenious man who knows he is possessed of inventive faculties, readily imagines the railroad field is open for his industry, and he proceeds to invent appliances he supposes ought to be in demand. For instance, one perceives that locomotives still continue to throw sparks, and he gets figuring on how this could be prevented in a better way than by the ordinarily used appliances. It is no very difficult matter to hit upon something not in use which seems feasible. He gets out a drawing and takes it to a patent lawyer. This gentleman on examination finds the leading idea as old as the hills, but he knows his business and secures a patent on a combination. When the inventor, fully protected with letters patent, applies to a master mechanic for permission to try his device, he is indignant on being told that the invention had been tried years ago and was no good, and does not believe a word of it. It is natural that an inventor should be surprised to hear that an appliance which he worked out of his inner consciousness was old, but such coincidences of invention are very common, and railroad mechanical men are so much importuned to try devices of the kind that there is good excuse for their not being very patient in listening to the inventor's extravagant estimate of the savings of all description that the invention will effect. It is too often much easier to figure up the savings that an invention will effect before it is applied than after it has been in service.

The men who reinvent old devices are deserving of sympathy for unknowingly wasting ingenuity, but the ordinary patentee who rejuvenates old appliances does not do so ignorantly. There are a good many railroads who are paying royalty on inventions that were public property long ago. Inventors of that class can not be too rudely treated.

The Outlook.

Complaints about business conditions and prospects are by no means uncommon, but General Miller, president of the Galena Signal Oil Co., a remarkably shrewd business observer, is reported as saying:

Prosperity is in evidence not only in this country, but also in Germany and Great Britain. The steel industry, which is taken by many as the safest barometer of business, is in a flourishing and substantial condition. Orders for steel are coming in in excess of the capacity of the mills, and the industry will enter the new year with prospects that 1913 will establish a new high record in output.

In line with other branches of business, the copper industry is enjoying an unexampled period of activity, with indications that consumption will continue on the increase for a long time to come. The revival of business in general is a natural sequence of restricted consumption over the last several years. The promise of large crops has strengthened confidence, and consumers are anxious to replenish depleted stocks.

Railway Club Meeting.

With the passing away of the summer months comes duties and distractions of winter, among them the attending of railway club meetings. The meetings of railway clubs have performed wonderfully good services by encouraging the people who attend to study the subjects that come up for discussion and to form the habit of expressing their views verbally. No matter how familiar a person may be with a subject it requires much practice in speaking before an audience to eliminate the nervous feeling that causes inexperienced speakers to suffer from what is known as stage fright. Many men will think that they are so familiar with the subject under discussion that they will add materially to the information brought out, but when they stand up and feel that all eyes are upon them the information they expected to send forth suddenly vanishes and they sit down after uttering a few incoherent remarks. That is an indifferent beginning, but repetition of the experience soon overcomes the weakness and by degrees the person who had been noted for nervous incoherence, develops into a fluent speaker. Not a few of the leading speakers in our railway clubs and associations have gone through the experience described.

The writer has experienced the satisfaction of encouraging timid speakers until they subsequently became fluent. One member of the Railway Master Mechanics' Association was an industrious worker on committees, but he was utterly dumb when discussions were going on. We took up the question seriously with that member and he protested that nervousness prevented him from giving utterance to a single word. Memorize ten words was the advice next given and give yourself the novel pleasure of hearing your own voice in public. The advice was taken and that Master Mechanic became a fair speaker and became president of the association.

We are afraid that the subjects investigated and discussed by the railway clubs and even by the mechanical associations are of less interest and importance than they were ten years ago. The cause for this, no doubt, is that the most interesting subjects have already been before the various clubs and the officials managing the clubs hold that there is no use threshing straw that has been through the mill One of the most successful editors of technical papers in the United States once remarked to the writer, that after five years any article might be reproduced without being recognized except by a very few studious readers. We think the same policy would be good if adopted by railway clubs and mechanical associations. The revivified information would be entirely new to most of the members and old heads would be no worse from having their memories freshened up.

The revival of old subjects would be much better for the members than the growing practice of using the railway clubs to give publicity to proprietory inventions. Helping to advertise new devices has a certain value, but we consider it much more edifying for railway clubs to ventilate subjects that the majority of railway men come in contact with through their daily experience. There are plenty of live subjects that can still be ventilated and discussed to good advantage, and nothing is so certain than that improvement in writing and speaking comes only by experience.

Noticing Things.

A roundhouse foreman, who has to perform the functions of an engineering physician in diagnosing all the maladies that locomotives are heir to, needs to have a vast fund of information to draw from, the information that comes only of ripe experience and keen observing habits. It is amazing, the capacity for not seeing things that the ordinary human being possesses. Civilization seems to vitiate people's powers of observation, for in the savage state life and safety nearly always depends on noticing signs of danger and when this source of fear is taken away the observing faculties become blunted. Our methods of popular education are also to blame for the blindness to details which afflict the present generation. Too much attention is devoted to loading the memory with facts or lore, while ignoring the valuable training of requiring pupils to acquire the information that comes from observing habits. The habit of noticing things can be readily developed, if those concerned will only impress upon themselves the practice of accurate observation. We do not recall any form of amusement more edifying than the games that turn upon the number of things noticed.

The utility of possessing the observing faculty comes out strongly to those whose duty it is to inspect machinery. Some engineers will make a round of inspection and fail to see loose nuts, absent bolts or cracked parts. Another man finds these defects as by instinct, but really because his observing faculties are cultivated and keen. Some men in charge of shops will walk through the place where they reign, with their eyes open and merely obtain a general idea of what the place contains; while others will note every detail. Macaulay, the famous historian, was said to have such a keen memory for details, that he could walk past a shop window and afterwards describe everything that was to be seen. Imitating that wise man's example, makes a highly edifying game for many folks, and it is wonderful how expert they become at remembering details of the various articles seen in a shop window. Girls as a rule are more skilful in this game than boys, probably because they are in the habit of noticing particulars of each other's dresses.

If the engine-house foreman practices going quickly around the buildings and training himself to note as many things as possible about the engines or machinery, he will soon come to perceive at a glance everything that requires attention. The advantage to an engine-house foreman having the capacity for noticing things was strikingly illustrated once when the writer visited a large roundhouse in an Eastern State. As we were strolling around with the foreman, an engineer came up and complained that the tender of his engine rode so hard that it shook the coal off and was ballasting the road with coal costing four dollars a ton. The fireman had to ride the greater part of the time upon the tender, and he complained that the rough riding was shaking his teeth loose.

The foreman remarked that there had been numerous complaints lately about tenders riding roughly, and he attributed the trouble to springs they were receiving from a spring maker who had commenced recently to supply springs to the company. He expressed the belief that the springs were too stiff which was causing the rough riding.

By this time we had reached the tender that was shaking out the fireman's teeth and the springs did not appear to be too heavy for the weight carried; but the foreman said that he had made up his mind to put in a lighter set. The writer had had considerable experience with rough-riding engines and tenders in his time, and felt moved to look for a cause of the rough riding different from stiff springs. He noticed that the springs reached almost to the ends of the pockets, leaving very little room for movement; close examination proved that this was the probable cause of the rough riding, and the proper remedy was applied without delay. It seemed strange that several tenders were being shaken to pieces without the cause of the defect being detected at once. A new make of springs had been introduced and a mistake had been made in specifying the length with the result stated.

Fair Play for Railroads.

Senator Lodge of Massachusetts says that the cost of operating railroads is steadily advancing. Wages have risen and other expenses have increased. At the same time the Interstate Commerce Commission stands at hand to prevent the railroads from raising rates. Such conditions cannot continue. The only body in the world that can operate a railroad at a loss is the government, which can charge the loss up to the people in the form of increased taxes. This pursuit of the rail-

roads, this hunting down of the railroads, goes on with increasing force every day. It has gone beyond the bounds of reason. We shall not gain in the long run by this blind assault upon everything American that has any appearance of prosperity.

Adoption of a Standard Car Coupler.

The recent death of Major Eli H. Janney, inventor of the car coupler, which bears his name, has led to the repeating of stories about how what is now the standard type of car coupler came to be adopted by railroads and its use made compulsory by the United States government.

The method of coupling railroad cars together has been a development of the fittest, and has seen many changes. The first method of coupling was by means of a chain and hook, which is still largely used in Europe, and was kept up on our coal roads until the safety appliance act was passed which made the use of automatic couplers compulsory. For freight cars nearly all railroads came by degrees to use a link connecting the drawheads held by pins which was known as the link and pin coupler. By the year 1870 this style of coupler was almost universally used. A serious objection to its use was that in coupling cars the switchman had to guide the link into the drawhead, and unless he was quite expert he was liable to have his hand crushed. Hand crushing became a very common disaster. In the year 1891, 415 men were killed and 9,431 injured coupling cars.

Public opinion demanded that a safer method of coupling cars should be adopted and thousands of inventors labored on the problem of making link and pin couplers automatic; but without success. Major Janney perceived the weak points of the old system of coupling, and in 1873 invented an entirely new form, which became known as the vertical type of car coupler.

As all the railroads were using link and pin couplers, it seemed a hopeless task to induce them to change to a new form; but the inventor of the new type was persevering and the numerous accidents happening daily to men engaged in coupling cars kept public opinion keyed up to the demand for a change. The railroad companies left to their master car builders the duty of selecting a satisfactory car coupler. The question was taken up by the Master Car Builders' Association, and under the auspices of that organization a variety of public tests of car couplers were carried out. In the Master Car Builders' Association two opposing sides developed, one side favoring the link and pin; the other the improved form.

Meanwhile the Pennsylvania Railroad Company, which has always been noted for progressive tendencies, began using the Janney coupler, so by degrees railroad men got gradually familiar with its construction. But year after year went past without any sign of the Master Car Builders' Association coming nearer to an agreement, when in 1887, by a move of shrewd parliamentary practice, representatives of the Pennsylvania Railroad had a resolution passed by the Master Car Builders' Association, favoring the adoption of the Janney type. The Pennsylvania Railroad Company wanted the Janney type of coupler adopted as the standard of the Master Car Builders' Association, and they employed two remarkably able representatives in John W. Cloud and Edward B. Ball, who worked through the resolution favoring the vertical plane coupler. That really ended the struggle.

Pumps Failed to Work—Result: Invention of Barometer.

Among the scientific questions that have reached this office is: "What is the Torricelli tube, and who was Torricelli?" The answer necessarily calls for particulars about a great discovery and a highly important invention.

The ancient belief was that water rose to follow the piston of a pump because "Nature abhorred a vacuum." For many centuries of a civilized world, that explanation was regarded as satisfactory. But "the world do move," as the colored sage remarked, and it happened about the year 1640, a deep well had been sunk in Florence, Italy, and it was found that the pump would not raise the water from a greater depth than thirty-two feet. The suction pump is of great antiquity, and is said to have been invented by Ctesibino of Alexandria about the year 230 B. C. But notwithstanding its great age, the pump would not abhor a vacuum with sufficient intensity to raise water more than thirty-two feet, and that fact was not discovered or made widely public until the difficulty with the Florence well was encountered.

The practical water raising artisans of that day being vanquished, they naturally applied to the man of sciences, who happened to be Galileo, who had become famous through first establishing the value of the vibration of the pendulum as a means of measuring time, and also had discovered the law of falling bodies and other laws relating to natural phenomena, so that he has properly been regarded as the father of modern scientific methods. But with all his knowledge Galileo was unable to explain why the pump would not raise the water from any depth, and, being within a few months of the end of his life, he did not care to undertake new investigations; but he commended the solving of the mystery to a friend, Torricelli, a young philosopher.

Torricelli at once took up the investigation of the mystery, which by this time was exciting the learned men of Florence. To experiment conveniently, Torricelli employed a long glass tube, and used different fluids, which brought the knowledge that the height of the column depended upon the specific gravity of the fluid. He closed the tube at one end, and filled it with mercury. Then he placed his finger on the open end and dipped in a basin of mercury, and holding it up vertically, permitted the contents of the tube to settle.

It was then found that a column of mercury 27½ inches high stood in the tube. On comparing the height of this column of mercury with the height of the column of water raised by the pump, it was found that the height agreed in an inverse ratio of the specific gravities of water and mercury. It was then natural to reason that both columns were suspended by the pressure of the atmosphere.

Further experiments proved that the height of the column diminished when the apparatus was taken up a mountain, and also that it varied slightly with changes of weather. The influence of the latter was, that the pressure of the atmosphere varied at the same place. To indicate this varying condition, Torricelli made a barometer of a glass tube charged with mercury, thereby inventing the Torricelli tube, which forms the barometer. It is closed at the top and open at the bottom end, which is immersed in mercury. All barometers are modifications of this invention. The invention was the result of knowledge, ingenuity and industry.

The Relation of Eccentrics to the Crank Pin.

The opinion that in adjusting the Stephenson valve gear, and when the valve is given an equal amount of lead in the forward and backward gear, the eccentrics are at an exact distance from the crank pin is an error. A careful measurement will show that there is sometimes a considerable variation. The eccentrics are necessarily set from the center line of motion and not from the location of the crank pin. They are adjusted so that the bottom arm of the rocker travels an equal distance on each side of its central position. The eccentric rods are usually long, and the location of the axle centers being often near the lower center of the rocker arm, the variation of the point at which the eccentrics are correctly set may not be great, but they invariably differ somewhat from the point that is equidistant from the crank pin. For practical purposes they may be set temporarily at that point before beginning the process of adjustment, when the resulting experiments will show the changes that become necessary.

Efficiency in the Man.

Much is heard these days about efficiency and hardly a mechanical magazine or paper is published today in which some sort of efficiency is not mentioned.

We read of shop efficiency, which is usually a general treatise on the subject of best methods and resultant economics, cost efficiency, machine efficiency and efficiency of various tools, shop construction and last but not least the ever present argument as to the most efficient tool room location.

A prime factor which seems to have been overlooked in most cases, and upon which not only depends all efficiencies, but ultimate success as well, is efficiency in the man.

The "boss" is the man upon whom depends all. In the old days, our grandfathers were usually the bosses themselves and the machine shop of those days was usually a "hand to mouth" proposition. There were few fixed standards, a machinist was invariably a general all-around man and the restricted field in which each shop operated was a very reasonable excuse for the methods then employed.

Today we have organizations with emphasis upon the word, and the layman today really does not comprehend what, in its fullest sense, that word means.

Organization means such a thorough and systematic grouping of various forces that in the event of any factor becoming inefficient it shall be immediately recognized and remedied, that in the event of the loss or transfer of any person, even to the president of the company, such change shall not affect the forward and uninterrupted movement of the whole.

In the handling of the mechanical problems of this progressive age, when all else is said, we must have an efficient head, a head of the organization, a head of each department and then if efficiency prevails we can reckon success.

Today the technical schools turn out good men and if they are not good men, technically, they can't "pass," but—and here is the rub—we then have a fine mechanic, an expert mathematician, and withal a scholar, competent to judge a taper to a degree to reason from a theoretical standpoint what is wrong or what should be, but what we must have first in a head of any organization is the ability to read character, study human nature, control men. In a word, we must in a sense have a diplomat, then he must be a man of original ideas, able to meet emergencies with good, sound inventive, instinctive sense.

The correspondence school graduate of today probably comes nearer, in the majority of cases, being an altogether "capable" man, for the reason that he is undoubtedly employed at the very occupation which he in time proposes to superintend, while at the same time he is grounding the "book knowledge" necessary for him to have. Another reason why the correspondence school graduate should be competent is that he has probably "worked his way" and when one works and pays for knowledge it is pretty apt to be digested. Without any attempt at odious comparisons, the large percentage of college men who waste their opportunities is undoubtedly due to a careless apathy on the part of the student who has had his way paid for him.

The efficient man is never put about in an emergency, and without being overbearing he soon impresses his men with a well founded opinion that he knows.

Elements of Business Prosperity.

A very shrewd business man once made the assertion that the interests which keep the world of business going are capital, management and labor, which form a three-legged stool where each interest is dependent upon the others. Of late years railway circles have become familiar with the expression community of interests, which embraces the welfare of all the forces that keep business active.

The origin of community of interests is to be found in a common possession of the inherent principles of human nature. The great region of inquiry and interest is not the world of nature but human nature. The broadening and the unifying influence of material progress has only fertilized the soil of human nature, whose chief product of progress ought to be a recognition of the principles of moral equity. Weak human nature influences the capitalists, the manager and the worker to claim more than a fair share of production, but public opinion ought to be strong enough to deal equity to the contestants without threats of ruin being bandied from one to the other.

Rise of Engineers' Brotherhood.

The locomotive engineers of the United States were among the first wage earners to attempt combining together for material protection. In 1855 a locomotive engineers' convention was held at Baltimore and the Locomotive Engineers' Association was organized. There was not much vitality to that union, for there was a tendency among the leaders to favor machinist engineers at the expense of the others, but it dragged on a feeble existence until succeeded by the Brotherhood of the Footboard, which did not live very long, but helped to inspire among locomotive engineers the advantages of union. In 1863 the Brotherhood of Locomotive Engineers was formed by W. D. Robinson, and has enjoyed a highly prosperous career, growing in influence every year.

Statement of Grand Chief Stone.

We regret that want of space prevents us from publishing the masterly summing up which Grand Chief Stone, of the Brotherhood of Locomotive Engineers, made before the Arbitration Board that is dealing with the question of engineers' pay in the Eastern territory. The railroads interested had the best talent at their command and statistics compiled by a great number of experts; but Grand Chief Stone by his unaided labors, was able to give categorical answers to all the claims made by his opponents. A striking feature about the discussion, which naturally aroused some personal feeling, was the fair manner in which Mr .Stone stated his case. Throughout the whole controversy he carefully avoided all personalities, although the other side gave much provocation, indulging in extravagant statements.

The whole of Mr. Stone's statement appears in the *Locomotive Engineers' Monthly Journal* for September and we earnestly recommend every person interested in the question at issue to procure a copy of that publication and read it carefully. They will find that if Grand Chief Stone is not a real orator, few speakers can equal him as a clear exponent of facts, and facts—though not always the basis of eloquence—they should be the prime moving factor in all earnest discussion.

Parcels Post Rates.

A great many of our readers will be interested in the parcels post rates that will go into operation on January 1 next.

Senator Bourne, chairman of the Senate Committee on postoffices, has issued a general circular letter, in which he gave the following information as to classes and rates: "Any article is mailable if not over 11 lbs. in weight nor more than 72 ins. in length and girth combined, nor likely to injure the mails or postal equipment or employees. There will be a flat rate of 1 cent per ounce up to four ounces, regardless of distance. Above four ounces, for first pound, each additional pound and 11 pounds upward, respecively, rural route and city delivery, 5, 1 and 15 cents, respectively; 50-mile zone, 5, 3 and 35 cents; 150-mile zone, 6, 4 and 46 cents; 300-mile zone, 7, 5, and 57 cents; 600-mile zone, 8, 6 and 68 cents; 1,000-mile zone, 9 7 and 79 cents; 1,400-mile zone, 10 cents, 9 cents and $1; 1,800-mile zone, 11 cents, 10 cents and $1.11; over 1,800 miles, 12 cents, 12 cents and $1.32. The postmaster-general may make provision for indemnity insurance and collection on delivery, with additional charges for such service, and may, with the consent of the Interstate Commerce Commission, after investigation, modify rates, weights and zone distances when experience has demonstrated the need therefor."

Catechism of Railroad Operation

Questions and Answers. Second Series.

(*Continued from page 331.*)

The Mallet Articulated Locomotive.

By F. P. Roesch.

Mr. Frank P. Roesch, who is contributing several articles to our Catechism of Railroad Operation course, is master mechanic of the El Paso and Southwestern System at Douglas, Ariz. He is not a stranger to our pages for he was the first to establish commercial mileage rating which he advocated in Railway and Locomotive Engineering several years ago. He is first vice-president of the Traveling Engineers' Association and a prominent member of the American Railway Master Mechanics' Association.

Mr. Roesch was born in Alsace, France, and emigrated to this country with his parents when six years old, landing at Chicago, where he first entered school, finally graduating from high school at the age of thirteen. At the same time he was studying mechanical engineering under the direct tuition of his father, who was a graduate of Oxford, England, and Heidelberg, Germany. His parents moving West, he entered the employ of the C. R. I. & P. Ry., at Trenton, Mo., as machinist apprentice, and upon completion of his apprenticeship went to Denver, Colo., with his parents, his father having taken a position as mechanical engineer of the Denver & South Park Railroad, with which road Frank also identified himself as a machinist, in 1883, being sent to Gunnison, Colo., as roundhouse foreman. Leaving that point in November of the same year, he entered the service of the Rio Grande Western at Salt Lake City, Utah; first as machinist, afterward as locomotive fireman. From there he emigrated to Sacramento, Calif., and was there employed, first as a locomotive fireman, afterward as machinist; laid off on account of slack business and was next employed as division foreman at Winslow, Ariz., on the Atlantic & Pacific Railroad, now the Santa Fe.

He resigned in the spring of 1885, knocking about the country and finally landing at Fernandina, Fla., where he took the position of general foreman with the F. R. & N. Railroad, resigning at the end of a year to take position of locomotive engineer. On account of the death of his father in Denver, in 1886, he returned to Denver and was first employed as general foreman of the D. & N. O. Ry., now the C. & S., and upon the completion of that road, took position of locomotive engineer, serving as both freight and passenger engineer for nearly ten years, when he was promoted to the position of road foreman of engines in 1899, and in 1901 to the position of general traveling engineer of the C. & S. Ry., and the Santa Fe joint tracks. During the time he was employed as general traveling engineer he spent most of the time in conducting various tests, such as indicator, dynamometer, etc., and established tonnage ratings for all locomotives over the entire C. & S. System. In the Spring of 1903 he was offered position as master mechanic of the C. & A. Ry., at Slater, Mo., which he accepted and held until he took the position of general manager of the Hicks Locomotive & Car Works, Chicago, Ill., January 1st, 1905. Owing to the continued ill health of his family he was obliged to resign this position after two years and accepted the position of master mechanic with the Southern Ry., first at Birmingham, Ala., and later transferred to Spencer, N. C., the Spencer shops being the largest shops on the Southern Ry. at that time. As the health of his family did not improve, he was again compelled, after two years, to resign, in order to find a drier climate at a higher altitude, accepting his present position in November, 1908.

These notes show that Mr. Roesch has enjoyed a highly varied experience, most of the changes having been owing to the delicate health of his wife. Honorary membership in the Master Boiler Makers' Association was conferred upon Mr. Roesch for work done on the Association's Rules and Formulas. In a high degree he combines the practical and the scientific department of mechanical engineering.

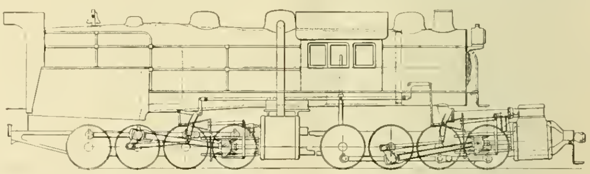
HISTORICAL.

The Mallet Articulated Locomotive derives its name "Mallet" from the original designeer, Anatole Mallet, a celebrated French engineer. It is termed an "Articulated" locomotive, meaning "jointed," from the fact that it is flexibly constructed. We are accustomed to associate the "compound" feature with the Mallet locomotive, although it is not necessarily of the compound type; quite a number of locomotives of this design having been constructed, using high pressure steam in both sets of cylinders; or, in other words, of the simple, non-compound type. As all defects arising to a Mallet Articulated locomotive of the single expansion type, however, would be common to any other single expansion type of locomotive, this class will not be considered in the following Catechism, the questions and answers relating thereto covering only the Mallet Articulated Compound Locomotive.

CATECHISM.

Q. What is a Mallet Articulated compound locomotive?

A. It is a locomotive having two separate and distinct engines under one boiler, the boiler being rigidly attached to the rear engine, but simply resting on bearing pieces on the forward engine, thereby allowing the forward engine to swing or curve laterally, independent of the rear engine. The rear engine taking steam direct from the boiler and exhausting it into a receiver, from whence it is conveyed to the cylinders of the forward engine.



SCHENECTADY MALLET COMPOUND. ERIE R. R., 1906.

Q. What two types are commonly used in this country?

A. The Baldwin and the American Locomotive Company types.

Q. In what manner do these differ in construction?

A. In the manner in which steam is admitted to the low pressure cylinders in starting; the Baldwin locomotive having a starting valve that consists simply of a pipe conveying steam direct to the receiver from the boiler, the American locomotive being equipped with an intercepting, reducing and separate exhaust valves.

Q. Describe the Baldwin type of Mallet locomotive.

A. In the Baldwin type, the rear engine, connected rigidly to the boiler, receives steam direct through the live steampipes. This steam, after being ad-

mitted through the valves to the cylinders, is exhausted from the cylinders into a receiver, from whence it is conveyed, by means of flexible connections, to the low pressure steam chests. After being again expanded in the low pressure cylinders, it is finally exhausted through the stack. The starting valve on this type of locomotive consists of a valve operated from the cab, which admits steam of reduced pressure, through a pipe, to the two ends of the high pressure cylinders, from whence it passes to the receiver, and so on to the low pressure cylinders.

Q. Describe the American type of Mallet compound.

A. The general construction of this locomotive is practically the same as that of the Baldwin type, the difference being in the manner in which live steam is conveyed to the low pressure cylinders in starting. In the American type, instead of having a manually operated starting valve, an intercepting valve is employed, so designed that when the throttle is open, live-steam passes by the intercepting valve, through the reducing valve, and into the receiver; from thence to the low pressure steam chests, and will continue to pass to the low pressure steam chests in this manner until the pressure in the receiver has been built up to about four-tenths boiler pressure, when the intercepting valve automatically closes, allowing the engine to work strictly compound thereafter. The American locomotive also has a separate exhaust valve, so that either in starting or to prevent stalling on a heavy pull, the steam from the high pressure cylinders can be exhausted direct to the atmosphere, thus reducing the back pressure against the high pressure pistons, thereby increasing the power of the locomotive in the same proportion. The low pressure cylinders, during this time, receiving live steam direct through the reducing and intercepting valves.

Q. What difference is there in the power of the two types of locomotives on hard pulls attributable to the different methods of admitting live steam to the low pressure cylinders?

A. It is claimed that there is quite an appreciable difference in favor of the American Locomotive Company's design owing to the fact that with their design of intercepting and separate exhaust valves, the full power can be obtained in the low pressure cylinders, and, at the same time, the back pressure can be eliminated in the high pressure cylinders, due to the separate exhaust valve allowing the back pressure to escape to the atmosphere; while in the Baldwin type, the starting valve being so arranged as to connect both ends of the high pressure cylinders, it is evident that the back pressure in the high pressure cylinders will practically equalize with the initial pressure, thereby throwing the burden of the work on the low pressure cylinders.

Q. What are the advantages and disadvantages claimed for the two methods employed to admit steam to the low pressure cylinders?

A. In the American type the advantages consist in increased power when starting, or when necessary to cut the engine into simple, to avoid stalling on heavy pulls. The disadvantages consist in a greater number of parts, thereby, in a measure, increasing liability of failure. In the Baldwin type the advantages are simplicity and decreased liability of getting out of order. The disadvantages are, that the power of the locomotive is only appreciably increased momentarily; that is, only when starting a train, as after the train has been started, if left working simple, the pressure on each side of the pistons in the high pressure cylinders becomes almost balanced, and as the pressure to the low pressure cylinders is reduced, the power of the engine is not augmented to any extent above what it can develop working strictly compound.

Q. Where and how do the high pressure engines of the Mallet compound type get steam?

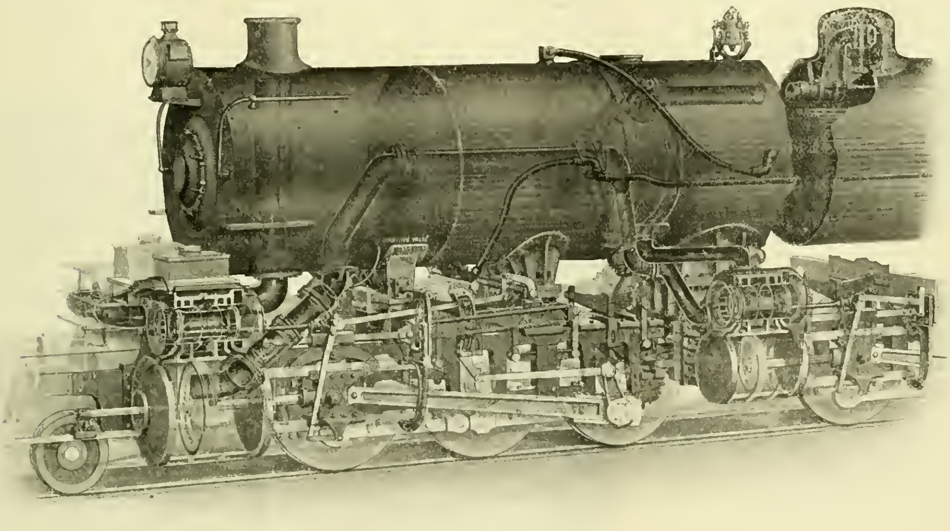
A. Direct from the boiler through the steam pipes leading to the steam chests, when the throttle is open.

Q. How do the low pressure engines obtain their steam?

A. From the exhaust of the high pressure engine, conveyed through a flexible receiver, except when working simple; that is, with the starting valve open; in which case the exhaust steam from the high pressure cylinders is augmented by a certain amount of live steam direct from the boiler, conveyed to the receiver pipe either through the starting valve, as in the Baldwin type, or through the intercepting and reducing valves, as in the American type.

Q. Which is the high pressure engine, and why?

A. The rear engine, or the engine rigidly attached to the boiler, is in all cases the high pressure engine. This in order to avoid the use of a flexible steam pipe for the purpose of conveying the steam from the boiler to the high pressure valve chambers.



PIPING ARRANGEMENT OF MALLET LOCOMOTIVE SHOWING FLUE LEADING THROUGH FEED-WATER HEATER.

Electrical Department

Steam Railroad Electrification.

The operation of steam railroads by electricity is no longer in the experimental stage. Electricity as a means of motive power has been tried out very extensively and has proved to the world that it is more reliable than steam and has many advantages over it.

In the consideration of electrification of a steam railroad one of the first questions asked is: "How does the electric locomotive compare with the steam locomotive as to its suitability for railroad operation?" The latter has two distinct parts, the boiler and the engine, each of which is designed for the service in which the locomative is to be placed. The boiler has its limits in size, due to the railroad conditions, and it is necesray to work the same at its maximum capacity so as to get the most power possible out of the locomotive. The engine is distinct from the boiler and the power it is capable of delivering at the driving wheels depends on its mechanical dimensions and the boiler pressure. A steam locomotive, in general, is designed so that the maximum tractive effort corresponds to about 22 per cent. adhesion between the drivers and the rails. The steam locomotive is not able therefore to start an increased load which requires more than the 22 per cent. adhesion, even if the coefficient is increased by the application of sand to the rails.. Moreover the tractive effort remains practically constant only up to 10 or 12 miles per hour for a passenger locomotive and 6 or 8 miles per hour for a freight locomotive, as it is necessary to use the steam expansively to obtain speed with a resulting decrease in the mean effective pressure.

The electric locomotive does not have the two distinct parts. The boiler is at the power house, which may be several miles away, and compared to the electric locomotive is unlimited in power. The torque of the motors is entirely different from the power obtained in the steam cylinder, in that the torque depends in the amount of current flowing through the motor. This value is at the control of the engineer, so that within safety limits as large a torque as desired can be obtained from the motors, and the maximum output is not fixed as in the steam locomotive supplied with constant steam pressure. This large variation of torque means large variation of tractive effort and draw-bar pull. It is therefore possible with the electric locomotive to take advantage of extra adhesion which may be natural, or caused by sand. A coefficient as high as 33 per cent. has been obtained. It is then only a matter of having sufficient wheel load on drivers to take care of the maximum draw-bar pull required. Besides the motors can be so designed that the rated maximum draw-bar pull will remain constant to 20 or 30 miles per hour.

The electric locomotive is in reality a transformer of power, as its engine part is separate from its service of power, which can be used in unlimited quantities from a main power house. It is not a prime mover as is the steam engine. Thus it is easily possible to design the electric locomotives to suit any conditions desired, high and low speed, large and moderate draw-bar pulls, in any combinations. Another very important consideration is the possibility of operating electric locomotives in multiple. Two electric locomotives can be connected together and controlled by one man. This arrangement affords flexibility of operation, where trains extend over a large variation of weight. Freight trains can be handled at a much higher schedule speed, especially in mountain divisions where grades are heavy. Handling heavy trains on heavy grades at higher speeds means a larger draw-bar pull, and of course weight on drivers. Both of these conditions are easily cared for in the electric locomotive design. The proper weight can be thrown on the drivers and the draw-bar pull can be obtained by equipping the locomotive with the correct number of motors of the proper horsepower.

In addition to the operating advantages mentioned above, the electric locomotive has many economical advantages, some of which are:

1. Due to the lack of smoke and gases maintenance charges on bridges, steel work, etc., is decreased.

ELECTRIC LOCOMOTIVES ENTERING SHEDS OF THE BOSTON & MAINE R. R.

2. There is a fuel saving on account of no standing charges against the electric locomotive; power is only used when hauling trains and no power is required when coasting and laying over; cheaper grade of fuel can be burned at the central power house and handled at less cost and at a higher efficiency.

3. Does away with turntables and decreasing shunting movements as an electric locomotive is operated equally well from either end. Much time is thus saved, resulting in increased capacity of the terminals.

4. Water stations, round houses, etc., eliminated.

5. The cleanliness is a comfort to the

passengers, resulting in increased travel.

The advantages of the electric locomotive have been discussed without reference to the electric system. It is true that each of the three main systems has its characteristics which makes it most suitable for certain conditions of grades and service, but this question does not enter into the general comparison. The three systems for steam railroad electrification are: the direct current, which can be divided into two divisions, namely, the 600 volts and 1,200 volts; the high voltage single phase alternating current; and the high voltage three-phase current.

The direct current, 600 volts, is the oldest. This system has been used for short distances and for terminals, but not for hauling heavy trains over long distances at high speeds. The Baltimore & Ohio Railroad installed this system for hauling their trains through the tunnel at Baltimore, where there are several grades, to eliminate the noise and smoke. The New York Central Railroad, in order to eliminate the danger due to smoke in the Park avenue tunnels electrified their tracks from the terminal in New York City to High Bridge on the main line, a distance of seven miles, and on the Harlem River branch to Woodlawn, a distance of twelve miles. At first all of the trains were handled by electric locomotives, but the railroad now operates many multiple unit trains and has extended the electrified zone to Hastings and to White Plains. All of the local suburban traffic can be handled by the multiple unit trains, and only the through trains need the use of an electric locomotive. Here, for example, is the New York Central Railroad, which originally electrified just to eliminate the danger of accident in the Park avenue tunnels, but which has since extended its electrified zone so as to get the benefit of the suburban traffic, which is so satisfactorily and economically handled by multiple unit trains.

Electrification was necessary in order to carry out the gigantic scheme of a extending the Pennsylvania Railroad into the heart of New York City. It was due to electricity that this feat was possible, as in no other way could the passenger trains be hauled under the rivers on either side of Manhattan. Cooperating conditions in these tunels are such, due to grades, heavy trains and high speed, that it would be almost impossible to handle the service by steam even if it were possible to eliminate the smoke. The electric locomotives in operation on the Pennsylvania Railroad are the most powerful ever built, for they continue high speed with the capacity for hauling heavy loads.

Operating in connection with and as a part of the Pennsylvania Railroad is the Long Island Railroad. When this latter railroad was taken over part of the local service was electrified for operation with multiple unit trains. Much criticism was heard, at the time, but the operation by electricity has had a wonderful effect and has built up the road to a point where it has the approval of all. Additional tracks were electrified for operating the multiple-unit system trains into the Pennsylvania station, and the railroad has under construction the electrification of several miles of track radiating from New York so as to carry the benefits of electrificational to additional suburban lines.

The Detroit River Tunnel electrification is another example of the advantages to be derived from electric operation. For several years the Michigan Central Railroad was obliged to transfer its trains across the congested Detroit River on ferry-boats. Due to the success of electric traction the building of a tunnel under the river was justified, and trains are now handled by electric locomotives without the delay previously experienced.

The direct current is especially adapted for large terminals, tunnels, etc., where the haulage of heavy trains is over a short distance, and where the third rail can be economically and easily laid.

The most notable example of heavy trunk line electrification is that of the New York, New Haven & Hartford Railroad, which has adopted the High Voltage Single Phase Alternating Current. On account of the electrification of the Park avenue tunnel of the New York Central Railroad some arrangements were necessary in order for the New Haven trains to run into the New York Terminal. Several plans were possible, but the one was decided on which would best suit the conditions for heavy trunk line operation, and one which could be easily extended in the future. Within a period of five years the success had been so gratifying to the railroad officials that further electrification was decided on, and the six-track Harlem River Branch and the immense freight yards have just been completed. The New Haven have not stopped at this, for the electrification is to be extended to New Haven. All trains both passenger and freight, as well as all switching, will be handled by electric locomotives. The operation of the electric switchers and their advantages over the steam switches is noticeable. These electric switchers can be in operation 24 hours a day every day. This fact, together with the quicker movements, is a big asset in favor of electric operation. The advantages of the single-phase system have been proven by the successful operation of the railroads using this apparatus. High efficiency in power transmission, with the elimination of sub-station rotating apparatus, is practically essential for trunk line operation. One striking characteristic of the Single Phase System is the possibility of obtaining a large amount of power, due to congested traffic at some point near the end of the line. This is an important requirement in trunk line service, and the ease with which this is accomplished with the single phase system, shows the advantage of this system.

The only three phase electrification in this country is that of the Great Northern. The conditions of service are heavy trains over mountain grades. The electrification of this section is extremely advantageous, as electric power is obtained at very low costs from a water-power development. The locomotives are so controlled that regulation of power is possible. That is, the motors are used to generate electric current when running down grade and pump same back into the trolley line, thus supplying power to locomotives operating up the grade. When regenerating power the train is held at a uniform speed down the grade, and the braking apparatus is ready for emergency conditions.

It is clearly seen from the above that the advantages to be derived from steam railroad electrification are many, and that electricity can be applied for all conditions of railroad service.

Electric Railways for India.

Small progress has been made in the construction of electric railways in India, but we learn from the Consular Trade Reports that the people are bestirring themselves in various parts of Hindustan to provide for themselves the conveniences of electric transportation.

Bangalore, in the native state of Mysore, ranking among the more important cities in southern India, does not possess a tramway system, but the Mysore government is considering building approximately ten miles of electric lines in the city and cantonment sections, with branches to outlying suburbs, Malleswaram, Basabangudi, and Frazertown.

The track proposed is one meter (3.28 feet), and tenders have already been received from firms in the United States to cover track material, car equipment, and necessary electrical apparatus for substation and cars. Definite action may be taken within a short time, possibly this year.

Another important city in this consular district without a street railway is Hyderabad, capital of the great Native State of that name, immediately north of the Madras Presidency. Hyderabad has 500,623 population, and a modern electric tramway system is one of the greatest needs of this rich capital. It is believed that such a project, with proper management, would prove feasible and profitable. We commend the attention of our manufacturers of electric appliances to the needs of Hyderabad.

Air Brake Department

Defects of L. T. Equipment

Before attempting to make any test to locate the source of any disorder of the New York L. T. brake equipment it should first be known that the handles of the varoius cut-out-cocks are in their proper postions, that is, all stop cocks should be open with the exception of cocks in the brake pipe and signal lines on the pilot and at the rear of the tender and the stop cock in the dead engine fixture.

All drain cocks shonld, of course, be closed after the pump is started.

If an engine is found upon which the brake will not apply with a movement of the automatic brake valve, all cut-out cocks being open, we would first ascertain whether the auxiliary reservoir of the control valve is charged, if so an opening should be created between the control valve and the double check valve. If no pressure issues when an application is attempted it indicates a defective control valve. If pressure does escape from the opening it indicates a "stuck" double check valve.

If the auxiliary reservoir portion could not be charged a leaky reservoir should first be looked for, then an obstructed feed or charging port, and if nothing was found wrong it would point to an obstruction in the brake pipe.

If the straight air brake will not apply but the automatic will it points to a defective reducing valve or a stuck piston in the double check valve.

If the automatic brake will apply in the emergency but not in service position, the stop cock under the brake valve being open, it indicates a defective triple valve piston packing ring or a defective leather and ring on the control piston.

If the brake applies in service and but a low brake cylinder pressure is obtained for a full service reduction it points to safety valve leakage, triple piston packing ring leakage or an auxiliary reservoir volume reduced by water.

If more than 25 lbs. cylinder pressure was obtained for a 10 lb. brake pipe reduction it wonld indicate leakage into the control reservoir.

If incorrect pressure is obtained from an application of the straight air brake it would indicate an improperly adjusted reducing valve.

If brake cylinder pressure falls after an application of the straight air brake and return to lap, it shows brake cylinder leakage.

If the brake cylinder pressure increases to the adjustment of the reducing valve after a light straight air application and return to lap position, it points to slide valve leakage in the straight air brake valve.

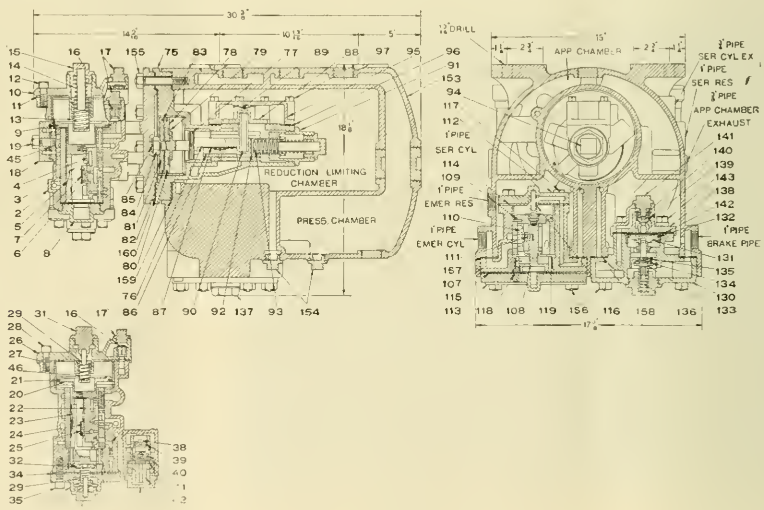
If the straight air brake will not apply the safety valve should be unscrewed before the reducing valve is fixed upon as the part at fault, as air issuing from the safety valve connection would indicate some trouble in the double check valve.

If the automatic brake leaks off it indicates leakage in the control reservoir, in the control reservoir pipe or in the automatic release valve of the straight air brake valve. It may possibly be due to a leak in the retain pipe accompanied by graduating or slide valve leakage.

If after a light application of the automatic brake, brake cylinder pressure increases, it is due to leakage into the control reservoir. If the brake cylinder pressure increases to 50 lbs., it is likely from the triple slide valve, but if it increases to the adjustment of the safety valve it must be from the rotary valve of the automatic brake valve.

However, if the rise in brake cylinder pressure is accompanied by a fall in brake pipe pressure the action is likely due to brake pipe leakage instead of any leakage into the control reservoir.

If the automatic brake applies and will not release, all cut-out-cocks and the straight air valve being in their proper positions, we would try the straight air brake valve in automatic



NO. 3—E. CONTROL VALVE.

release position and if the release then took place it would be safe to assume that the triple valve piston had stuck in the bushing or excessive packing ring leakage allowed the auxiliary to charge without moving the triple valve. If the brake did not release when the straight air valve insured that the control reservoir contained no air pressure we would conclude that the control piston was stuck in the bushing or broken.

While investigating any failure of the automatic brake to realese it must be remembered that the engine brake can be applied with an emergency application while the brake valve cut-out-cock is closed, and if the control valve has a quick action cylinder cap, the stop cock in the main reservoir supply pipe to the distributing valve can be closed and the brake applied either in the emergency or by a heavy service reduction that has reduced brake pipe pressure a few pounds below the point of equalization.

The brake applying when the brake valve cut-out-cock is closed is due to a flow of air from the brake valve through the control reservoir in emergency position.

The emergency or heavy service applies the brake when the supply pipe is closed by unseating the slide valve in the quick action cylinder cap allowing brake pipe pressure to enter the cylinders. In the latter case the brake valve cut-out-cock must, of course, be open.

If the brake will not release after an emergency application during which time the valve handle remained in emergency position for a considerable length of time, we would conclude that the failure to release promptly was due to an inoperative or improperly adjusted safety valve permitting the auxiliary and control reservoir to become charged to main reservoir pressure from the control reservoir pipe. A glance at the brake cylinder hand on the air gauge will show up a condition of this kind.

If the brake applies and releases all right except that the brake cannot be released with the straight air valve when the automatic valve is on lap position after a reduction of brake pipe pressure, it indicates that the control reservoir pipe and the retain pipes are crossed or wrongly connected or that a closed continuous feed pipe or some failure of the automatic release valve to open was preventing the release.

If the exhaust of brake cylinder pressure is intermittent it indicates an obstruction in the retain pipe, and if the last movement of the control piston happens to be toward lap position instead of release a light brake cylinder pressure may be trapped in the cylinders.

A light cylinder pressure with no air pressure in the control reservoir would indicate considerable frictional resistance to the movement of the control piston and a failure to entirely release may be due to both an obstruction in the retain pipe and excessive friction of the control piston.

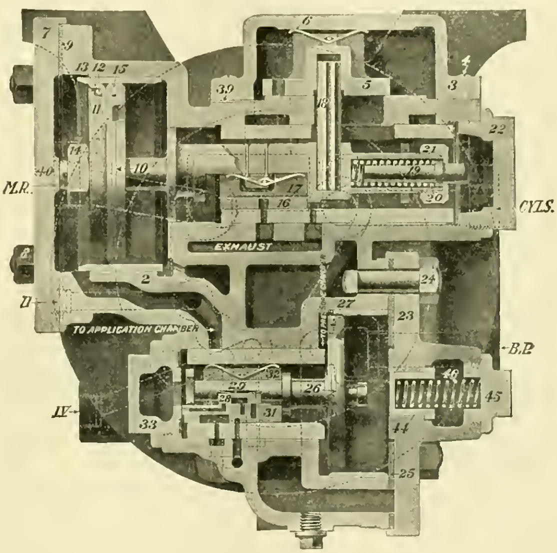
Should the straight air brake fail to release, both valve handles being in their proper positions, it is due to a movement of the control valve building up pressure on the automatic side of the double check valve which will be explained in connection with "brakes creeping on."

If the automatic brake is applied and valve, the automatic valve being on lap position, it would point to a further reduction due to brake pipe leakage or a leak into the control reservoir.

If the brake was to reapply after an emergency application, accompanied by a heavy blow at the brake cylinder exhaust port, it would be due to a stuck open emergency valve in the quick action cap.

A re-application with the brake valve in release position would, of course, mean a bursted horse or broken brake pipe or an insufficient air pump or main reservoir capacity.

If the brake was to creep on with both valve handles in their running



NO. 6. DISTRIBUTING VALVE.

during a release or shortly after the release it is found to re-apply we would notice the air gauges in order to find the reason, the re-application may be due to leakage in the brake pipe and an overcharged brake pipe as with modern main reservoir volumes it is impossible to move the brake valve handle to release position and back to running position without overcharging the small auxiliary reservoir of the control valve.

When dealing with modern engine equipment especial care must be given to the correct use of the various positions of the brake valves. Release position of the automatic brake valve is for releasing train brakes or charging an empty brake pipe, but running position is for releasing the engine brake, and the straight air brake is provided for handling the engine.

If the brake was to reapply after a release with the straight air brake positions it would indicate a leaky brake pipe and a "sluggish" brake pipe controller provided, of course, that the brake pipe has not been overcharged.

By a "sluggish" feed valve is meant one that does not promptly open to supply slight leakage in the brake pipe or in case where due to friction of the controller the triple valve is more sensitive to brake pipe reductions and operates to apply the brake before the controller can operate to supply the leakage.

It is also possible for the brake to reapply if the handle is placed in release position as the exhaust port of the triple slide valve is closed and any slight leakage into the control reservoir or pipe would apply the brake.

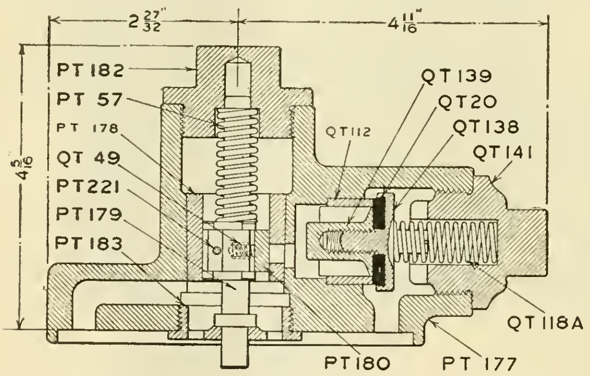
Should the emergency occur when the service is intended it would likely be due to a sticky triple piston or a weak graduating spring in the quick

action cap, but it is possible for the disorder to be due to a defective brake valve, which will be dealt with in a future issue.

Should the service occur when the emergency is intended it would indicate excessively crooked pipe work, and probably a stuck slide valve in the quick action cap.

Should an automatic application occur when the straight air valve is used it would indicate an obstruction in the reservoir pipe or a partly closed reservoir cock.

On the second engine in double heading, a re-application of the brake is likely to occur after almost every release with a long train which is due to the inevitable variation in brake pipe pressure on a long train, especially so when release position of the brake valve must be used, but the second engine brake will release along with the head train brakes upon the second movement to release position. If on the rear of the train with the brake valve cut out, the "sticking" engine brake should be released by what is termed "flashing" the brake off, that is, opening and closing the brake valve cut-out-cock in the shortest possible space of time.



QUICK ACTION CAP FOR NEW YORK CONTROL VALVE.

The brake on the second engine may not remain applied after an application from the lead engine, there having been no unusual action of the brake when the second engine was alone, and in this event the control reservoir pressure would escape from the exhaust post of the automatic brake valve, thus releasing the brake and it could be due either to a leaky graduating valve in the control valve or a case of crossed control and retain pipes, assuming, of course, that there is no leakage from the auxiliary reservoir, triple slide valve or control reservoir and connections to the atmosphere.

With the brake valve handle of the second engine in running position, the leaky graduating valve or any leak in the auxiliary reservoir that would reduce this pressure and allow brake pipe pressure to move the triple valve to release position would release the brake as the retain pipe is open to the atmosphere which is not the case if the brake is applied with the brake valve of the engine in question.

The control and retain pipes being crossed would have the control reservoir open to the atmosphere with the brake valve handle of the second engine in running position, and this would prevent the application of the brake when attempted from the head engine but the valve handle could be moved to lap position when the brake released under these conditions, and when then desired a movement to running, the proper position, would release them.

Brakes Failing to Release

The most frequent air-brake query that has come to our notice during the past few years is in reference to the gine brake.

In our replies we have always maintained that the creeping on of the brake, that is, the brake applying while the handle of the brake valve is in running position, is due to a combination of disorders, either of which being corrected, will cause the trouble to disappear.

It is evident that if brake pipe pressure is maintained at a predetermined figure the auxiliary reservoir pressure or pressure chamber air of a distributing valve cannot force an operating valve to its application position against an equal pressure or pressure in the brake pipe being maintained, leakage from the brake pipe to the atmosphere cannot result in an application of the brake.

Regardless of any condition of the feed valve or pressure controller the brake cannot apply unless there is a brake pipe reduction of not less than about 15 pounds per minute. At a somewhat less rate of brake pipe reduction, the pressure chamber air of a distributing valve can reduce the pressure by escaping through the feed groove without moving the equalizing valve, therefore, regardless of the condition of the feed valve, a brake-pipe reduction is necessary to apply the automatic brake.

When this creeping on of brakes is encountered the application of a new or repaired feed valve will sometimes overcome the disorder, but a little reflection on the subject will show that the feed valve has nothing whatever to do with the application or creeping on of the brakes unless the brake-pipe leakage should happen to be in the feed valve itself. The cause of the brake applying as previously stated is due to brake pipe pressure falling faster than the stored pressure chamber volume can escape, thereby creating the differential in pressure necessary to produce an application.

In attempting to locate any disorder or solve any problem connected with an undesired application of the E. T. brake, it must be understood that when the equalizing valve of a distributing valve is in release position, the application cylinder is open to the atmosphere and any leakage into this chamber would escape instead of building up a pressure and applying the brake, and if the equalizing valve is moved away from its release position we know at once that there has been a reduction in brake pipe pressure or an increase of pressure chamber pressure. The overcharge in the pressure chamber could be due to an inoperative safety valve and the use of emergency position of the brake valve or to a defective reducing valve and the use of the independent brake valve.

Brakes creeping on and brakes sticking are two entirely different disorders and in dealing with a case of brakes sticking we know, first, that brake pipe pressure must be increased above pressure chamber air before application cylinder pressure will be exhausted by the equalizing portion and when application cylinder pressure has escaped the brake cylinder pressure is relied upon to return the application portion to release position.

A glance at the air gauges at the time of release will show what is taking place; however, the more familiar one becomes with modern locomotive brake equipments the less positive we are about the exact cause of an unusual action of the E. T. brake, and at this time it is desired to touch upon one particular case of brakes sticking with the E. T. locomotive brake, and at a time when there is no air pressure in the application cylinder.

As the brake cylinder pressure is

relied upon for the return of the application portion to release position after an application, it follows that if the friction or resistance to movement of the application piston and its attached valves is in excess of the force of the brake cylinder pressure effective on the application piston, the brake is liable to be stuck, but ordinarily this could occur with but a very light brake cylinder pressure.

In a new distributing valve there is but very little frictional resistance to the movement of the application portion, but after the valve is in service a short time the application valve seat tends to become covered with corrosion and as a result considerable friction may be encountered in moving this portion and under such a condition certain methods of manipulation or lack of observation may permit a brake to remain lightly applied, provided that there is no brake cylinder leakage.

In order to clearly comprehend this action of a distributing valve in trapping a light brake cylinder pressure it is only necessary to find a locomotive with no brake cylinder leakage and with a distributing valve that has been in service for some time.

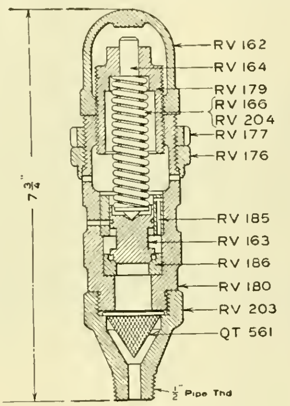
It may be difficult to find an engine with a brake cylinder leakage within the 5-lb. per minute limit, but it should not be difficult to find a distributing valve that has not had any attention within 3 or 6 months, and if such an engine can be found, the independent valve can be used with a short movement to slow application position and return to running position, that is, be returned to running position about the time the brake pistons start out of the cylinders, and several minutes' practice will enable one to stick the pistons 3 or 4 inches out of the cylinders, and have no compressed air pressure in the application cylinder.

After the brake is stuck in this manner it can be promptly released by a further application made with either brake valve when returned to running position.

To obtain a definite idea of the friction of the application valve of a distributing valve, close the stop cock in the cylinder pipe, remove the application cylinder, cover and the upper cap nut, then move the application piston back and forth in the bushing several times, note the force required, then open the stop cock in the supply pipe and with a main reservoir pressure of over 100 lbs. note the additional force required to move the piston toward application position.

The brake is assisted in sticking in the manner described by the fact that there is no friction to speak of between the exhaust valve and its seat when the piston first moves to application position, but the pressure on the exhaust valve after the brake is applied adds a resistance to the return of the parts to release position; but it must be understood that the brake remains applied in this manner only by very small volumes of compressed air entering the application cylinder such as would occur from the use of the independent valve as described or in the event of movements of the equalizing portion which could be caused by a failure of the feed valve to promptly supply a brake pipe leak.

A brake becoming stuck in this manner should be regarded as a possibility rather than a common occurrence, because if the brake valves are handled as they should be it cannot be caused by incorrect manipulation, and if the brake pipe feed valve is maintained in a reasonable state of efficiency there will be no movements of the equalizing



R. V. H. SAFETY VALVE.

portion of the distributing valve to admit pressure to the application cylinder in the manner necessary to produce this effect.

The manufacturers of the brake are aware of the possibility of the brake being stuck as described, and if it was considered serious or due to anything other than neglect or incorrect manipulation, it would not be difficult to arrange for the return to release position as it is done in the application portion of the No. 3—E control valve, and the only reason for bringing this to the attention of our readers is that there have been a few cases of overheated driving wheel tires under conditions that indicated the presence of a light brake cylinder pressure with no pressure other than atmospheric, in the application cylinder of the distributing valve.

Bringing this to notice may also serve to exemplify one of the most annoying phases of locomotive operation, and that is, no matter how carefully and concisely any rules are formulated to cover the manipulation and care of any part of the equipment, if there is any possible way of misconstruing them or of securing the opposite results from those intended, someone is certain to find it.

Sauvage Air Brake Attachment.

Leakage in the air brake system bears about the same relation to brake efficiency as friction does to perpetual motion, leakage from the brake cylinders being a loss of braking power and leakage from the brake pipe an indirect loss of brake, or train control, and this was evidently recognized by Mr. W. H. Sauvage, the well-known inventor of the air brake devices, before he invented and perfected a valve mechanism that counteracts or entirely overcomes the effects of leakage in the brake system.

By the addition of a suitably connected valve on the car and one on the locomotive, both brake cylinder and brake pipe pressures are maintained against leakage, brake pipe pressure is held constant up to the capacity of the air compressors without interfering in the least with the brake manipulation or operation, while brake cylinder and retaining pipe pressure is maintained at a predetermined figure from the brake pipe supply up to a point where the rate or volume of leakage is arbitrarily decided upon as impracticable or unreasonable to attempt to maintain, whereupon the supply is automatically cut off from the defective brake.

Incorrect supposition may lead to an inference that this involves a complex valve mechanism, but it is so astonishingly simple that the inventor's idea is the dominating feature, and while a premature conclusion might question an effort to maintain a variable quantity of leakage in various lengths of brake pipe during the time the brake is applied, on the ground that in the event of a defective attachment a release might actually occur at an undesirable or critical moment, but this possibility was foreseen and checkmated with the inception of the device.

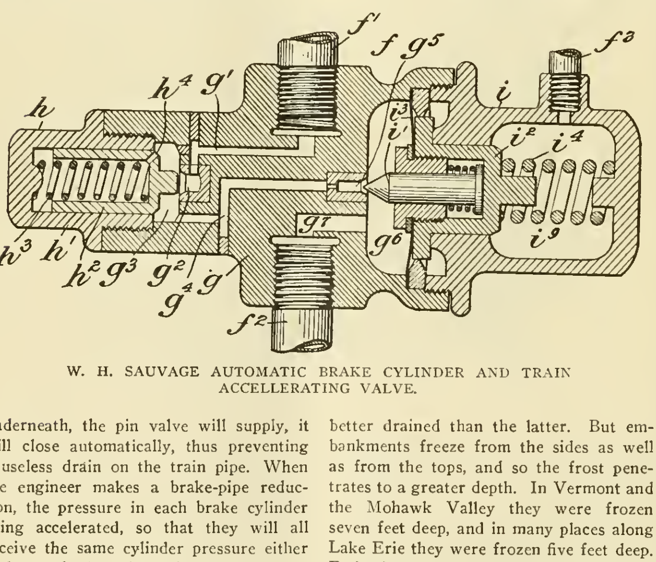
We wish to direct our readers' attention to the fact that the air brake department of Railway and Locomotive Engineering is edited with a view of disseminating among our air brake inspectors and repairmen, any air brake information we happen to be in possession of and not for the purpose of advancing any questionable theories or commenting upon or exploiting any experimental device, and there is no present intention to deviate from this policy.

The writer has had the pleasure of handling a locomotive brake with this attachment, and of observing the work of the car brake sustaining valve under a number of different conditions, and as a result a brief description will be given for the benefit of any of our readers who

may come in contact with the device.

At the present time we have a view of the brake cylinder sustaining valve, and a future issue will contain views of the locomotive equipment.

Connection f¹ leads to the train pipe, f² to the brake cylinder and f³ to the retaining pipe connection. The latter connection is only made when the sustaining features are not wanted when the ordinary retaining valve is in use, and left off when it is desired to maintain any predetermined brake cylinder pressure both in service and release position of the triple valve, subject entirely to the will of the engineer according to grade conditions. The student will at once note the diaphragm and pin valve attached, which is unseated by a low brake cylinder pressure and remains open until the triple valve goes to release position with the retaining valve turned down when it closes instantly. Should the leakage be greater than the choke-hole



W. H. SAUVAGE AUTOMATIC BRAKE CYLINDER AND TRAIN ACCELLERATING VALVE.

underneath, the pin valve will supply, it will close automatically, thus preventing a useless drain on the train pipe. When the engineer makes a brake-pipe reduction, the pressure in each brake cylinder being accelerated, so that they will all receive the same cylinder pressure either with standard or long-piston travel, acting much in the same manner as the K triple valves. On grades this valve will maintain the brakes to any desired cylinder pressure and at the same time keeping the auxiliary reservoirs fully charged, so that at no time can the engineer dissipate the air.

As previously mentioned the loss of brake pipe pressure in supplying brake cylinder leakage is prevented by the locomotive valve. This has three connections, the equalizing reservoir pressure governing the flow of main reservoir pressure to the brake pipe while the brake valve is in lap position.

The numerous tests which the appliance has undergone is absolute proof of its complete reliability.

Broken Rails in America.

Dr. Dudley throws no little light on the broken rail question. As last winter was the coldest ever experienced north of lat. 40 N. it shows that a standard specification for all railways is out of the question. Each company must take its local climatic conditions into consideration. During the first three weeks of January, 1912, over 4,000 rails broke in the State of Minnesota. None broke in pieces but just one fracture, and where track-circuits were in use the signals went to danger owing to the breaks short-circuiting the current. September and October were quite cool north of lat. 40 N., while November and December were comparatively warm. There was a warm, heavy reain of two or three days' duration in the West, followed by a sudden change to cold, and then the breakages soon commenced. It was observed in many places that more rails were broken upon embankments than in cuttings, which is unusual, as the former are better drained than the latter. But embankments freeze from the sides as well as from the tops, and so the frost penetrates to a greater depth. In Vermont and the Mohawk Valley they were frozen seven feet deep, and in many places along Lake Erie they were frozen five feet deep. Embankmnts on single lines were frozen deeper than those where there were four lines of way.

Nobody to Blame.

On July 4 an express train crashed into the rear of a delayed passenger train on the Lackawanna Railroad, near Corning, N. Y., killing forty persons and injuring many others. A very thorough investigation of the cause of the accident and many expert witnesses were examined, the engineer of the colliding train and the rear flagman of the delayed train having been held on criminal charges. The Grand Jury investigating this accident reported on September 17 that no one was to blame for the disaster, and the men held as presumably resp nsible were discharged. The officials of the Interstate Commerce Commission who investigated that accident blamed the engineer and flagman, which resulted in holding these two men, but the action of the Grand Jury exonerates them.

Pity the Poor Flagman.

The fate of the hind flagman is not a happy one under the most favorable circumstances, and the duties frequently involve real hardship and suffering. Something has happened to obstruct a train on the main track at night, and following instructions the flagman leaps from the rear of the moving train and armed with red light and torpedoes, plunges boldly into the darkness, perhaps facing rain, snow or sleet. These he disregards but hastens towards the headlight of a following train, which glares at him as he feels for a footing on the cross-ties upon some lofty bridge or long trestle. After much slipping and stumbling he reaches the prescribed distance of twenty-six telegraph poles or about one mile, plants his torpedoes and listens with eager ear for the signal of recall. If through haste to depart or inadvertance the signal is not given and the train moves on without him, that flagman may pass the night in soltitude, perhaps wet, cold and hungry, or until some train stops at his signal and picks him up. Such are the duties of a flagman and it takes pluck and endurance to fulfil them properly.

Two Hours Longer for New York-Chicago Fast Trains.

We understand that the Pennsylvania Railroad and the New York Central Lines have decided to change the eighteen hour trains run between New York and Chicago, and vice versa, to twenty-hour trains. The two hours' extension of time will make a material difference in the energy expended in the running of these trains, and will materially reduce the number of accidents. The traveling public will find really no difference in being kept two hours longer on the road during these long journeys.

Weed-Burning Device.

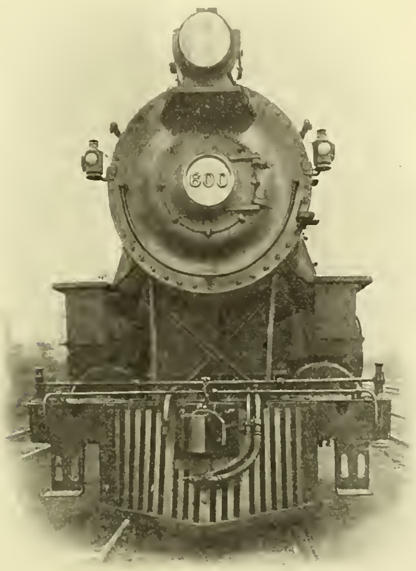
Wilbert W. Lamb, of Cincinnati, Ohio, has invented a weed burning machine for burning weeds and grass on railways. A company with a paid-up capital of $300,000 has been organized to manufacture and lease this machine to railroads. The machine is mounted on a railroad car and is composed of burners which feed gasoline to seven large tubes, consuming 200 gallons of fuel an hour while the car is running eight miles an hour, a speed which, it is said, leaves the rails and ties unheated, although every living thing coming beneath the fire dies.

Pacific Type Locomotives for Buffalo, Rochester and Pittsburgh

In the June issue of RAILWAY AND LOCOMOTIVE ENGINEERING, we took occasion to describe and illustrate the Mikado type of locomotives built by the American Locomotive Company for the Buffalo, Rochester and Pittsburgh Railroad. In addition to 7 of these Mikado locomotives there were also 3 of the Pacific type constructed by the same builders at the same time, and the enterprising railroad company has been submitting these locomotives to a series of tests with the older types of locomotives and in every instance the results of the tests show a considerable gain both in point of tractive power as well as economy in fuel and water.

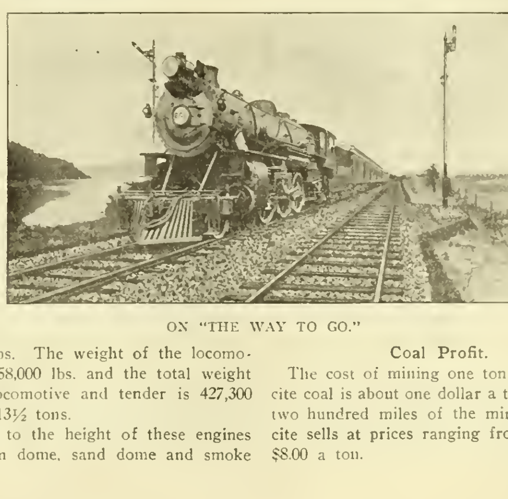
The Pacific type was designed for fast duty on heavy grades. The cylinders are 24½ ins. in diameter, with a stroke of 26 ins. The driving wheels are 73 ins. in diameter. The steam pressure is 200 lbs. per sq. in. The boiler is 83 ins. in diameter, and equipped with the Schmidt superheater. There are 240 flues 2 ins. in diameter and 35 flues 5¾ ins. in diameter, which with firebox give a heating surface of 3,625 sq. ft.

The firebox is large and is one of the features of these locomotives, being 108 ins. deep and 75¼ ins. wide. It contains a brick arch supported by arch tubes. This arrangement, together with the superheating device, considerably reduces the consumption of fuel and also reduces the labor in firing. The firebox door is opened and closed by compressed air, the fireman simply pressing a lever with his foot when about to put in coal.



PACIFIC ON THE BUFFALO, ROCHESTER & PITTSBURGH.

Each of these three locomotives has a driving wheel base of 13 ft. and a total wheel base including tender of 65 ft. 10½ ins. The weight on the drivers is 163,500 lbs. The weight of the locomotive is 258,000 lbs. and the total weight of the locomotive and tender is 427,300 lbs. or 213½ tons.



ON "THE WAY TO GO."

Owing to the height of these engines the steam dome, sand dome and smoke stack are dwarfed, the whistle lies flat along the top of the boiler. The bell also is lower and broader than on smaller locomotives and is operated by an automatic bell ringer actuated by the opening of a valve in the cab, and the electric headlight is in front of the boiler instead of on top. All the Buffalo, Rochester & Pittsburgh Railway passenger locomotives are equipped with powerful electric headlights.

The tender has a fuel capacity of 15 tons of coal and 9,000 gallons of water. This water capacity gives these locomotives a steaming radius under normal conditions of over 100 miles.

President Hill on Railroad Needs.

The quantity of freight offering for transportation by our railroads is causings blocks of traffic in many places, and loud demands are already heard for more railroads. President James J. Hill, who can analyze the railroad situation as well as any one, says:

"This country needs more railroad facilities. The railroads need not only more tracks and cars but more and larger terminals. Whenever business is good there is an actual freight blockade in New York City, Chicago, Pittsburgh, Buffalo, St. Louis, in fact, in every one of the large centers of the country. However, well equipped otherwise, the railways cannot render the service that the country requires until enlarged terminals are created.

"The capital for these improvements can be obtained only when the railroads are fairly and justly treated. It will probably require some industrial distress, as well as a campaign of education, to secure a recognition of these facts."

Coal Profit.

The cost of mining one ton of anthracite coal is about one dollar a ton. Within two hundred miles of the mines anthracite sells at prices ranging from $6.00 to $8.00 a ton.

The Evolution of Transportation

By W. N. MITCHELL.

Mr. W. N. Mitchell, the writer of the following article, has had a notable career and is one of our numerous business men who have raised themselves by sheer force of perseverance from a lowly position to one of commanding influence. W. N. Mitchell was born on a farm and received no school education. When he was fourteen years old he went to work as water boy on a Santa Fe construction train. A year or two later he secured a job as machinist-helper in a roundhouse, which he held for some years and then went firing on the Missouri Pacific. Then he began to realize the want of education and proceeded by a system of self help to acquire a knowledge of reading and writing. Teaching himself inspired the ambition to teach others, and in 1896 he opened in Chicago, a Correspondence School of Locomotive Firemen, work that fitted him to fill the position of general manager of the Railway Department of the International Correspondence Schools, a position in which he has achieved great success.

PART I.

To be complete, any story of the evolution of transportation would have to review the annals of probably more than seven thousand years. If history is correct, no doubt the first great transportation achievement was accomplished when Noah received his "train orders" and waited for the flood which launched the Ark.

As a matter of fact, one must go back beyond Noah's exploit to review this evolution, because the Ark itself was evident proof that a knowledge that wood would float was common even before this remote period.

Scientific researches conducted by archaeologists within the last quarter of a century have given undoubted proof that transportation facilities of various kinds had been considerably developed in very early days. The Egyptian pyramids, the obelisks, and similar monuments erected by the ancients, reveal the fact that some means of transportation, however crude they might have been, compared with those of the present day, were efficient enough to transport over great distances the huge stones of which these monuments were constructed.

The early races who lived around the Mediterranean Sea, where perhaps civilization had its beginning, grew in strength and commercial importance through the development of transportation facilities.

Perhaps the first actual transportation achievements were those of human burden bearers. Wonderful feats have been recorded of them. I believe it was Prescott who, in his "Conquest of Mexico," tells of a human "express service" performed by relays of the native Mexican Indians. The City of Vera Cruz is over 280 miles from the City of Mexico; yet each day fresh fish frrom the Gulf were served on the table of the Emperor in Mexico City.

History does not tell us how many of the early savage tribes had subdued wild animals, to take the place of human burden bearers. But going back to Biblical times, we are told of beasts of burden. The commerce between the early Asiatic and European races was carried on by means of caravans of camels. The Incas of Peru, who had developed a most wonderful civilization for their day and age, had subdued and trained to their service of burden bearing, the Llamas of the

W. N. MITCHELL.

Andes. The North American Indian contrived to fasten two trailing poles to his pony and to place across them the spoils of the chase. To this contrivance the name of "Travoix" was applied.

Rude trails through forest and over plain could not long accommodate the development of transportation, so for purposes of war or otherwise, as intellectual development and civilization spread over Europe, highways were constructed. When America was settled, the westward march of civilization was made first through forest trails, and later over roads that finally might by courtesy be called "highways." Many of these eventually took the form of toll roads. They were variously known as such or as "turn-pikes," and their extension from place to place and into new regions encouraged stage traffic and the development of hitherto unknown and unsettled portions of the country.

Probably the best known of the old turn-pikes in North America was the one extending from Trenton, N. J., to Steubenville, Ohio, this being an extension of an earlier turn-pike from Philadelphia to Lancaster. Such stimulus was given to the construction of these toll roads, or turn-pikes, in the last years of the seventeenth century, that in the State of Pennsylvania alone more than 2,300 miles of these roads had been constructed at a cost not far from ten million dollars. A notable highway of the early days was begun in 1806 when the United States Government commenced the construction of the National Pike. This highway was known at first as the Cumberland Road. It passed through Wheeling, West Virginia, and Columbus, Ohio, and later was extended to Vandalia, Ill.

From the earliest known period when anything like a road or highway was in existence, various peoples in different parts of the world had contrived crude forms of wheeled carts, that like the crude roads on which they traveled, went through a process of evolution from generation to generation, and stand in history as the forerunners of modern road vehicles. In the days when coaching was at its prime, the Conestoga wagons, the Concord coach, and similar vehicles, made history.

For centuries the development of transportation was along lines of travel by water, and for this reason such communities as there were, such towns and cities as had attained considerable growth and importance, were located along the shores of streams or bodies of water where the then known means of transportation were available.

In some parts of Continental Europe and in Egypt, and the country of which Babylon was the commercial center, extensive system of canals were developed at a very early period. Many of these were commercial waterways, although innumerable miles of such waterways had been constructed solely for the purpose of supplying irrigation to arid lands and to drain swamps. There is a well confirmed tradition, which through late researches has been considerably strengthened, that the Suez Canal was twice opened and closed a thousand years or more before the Christian Era began.

The stimulus which the development of highways gave to the transporting of freight and passengers in this country, attracted enterprising people to the possibility of constructing artificial waterways.

Many American canals have been

opened, operated, fallen into disuse, and discontinued since the history of American canals began. Only one canal of any great commercial importance which may be considered wholly as an interior waterway, remains in this country at the present day. This is the Erie Canal, the history of which began in 1803 when Gouvernour Morris suggested making a navigable waterway from the Great Lakes to New York. The subject was agitated in various ways for a number of years, resulting in the first ground being broken on July 4, 1817. In November, 1825, the canal was formally opened from Albany to Buffalo, 352 miles. Its cost had approached eight million dollars. At the present time this historical canal is undergoing a reconstruction which aims at making it more or less of a deep waterway between its terminae.

The development of waterways suggested the development of water craft, but the evolution of water craft was slow like the evolution of other vehicles of transportation, and was dependent on the development of the steam engine. Not until the steam engine had been developed far enough, so that it could be adapted to boats, did steam navigation become a fact. Further development was retarded from time to time through the fact that the ships themselves were not able to accommodate engines of the size and capacity which were evolved. As speed possibilities increased through improved design and the application of screw propellers, coal-carrying capacity had to be provided for. One does not have to go very far back into the past to realize how marvelous it was considered for an ocean liner to cross the Atlantic from land to land in seven days. Nowadays we are in fact surprised to hear that it has taken any such time to make this passage. We are not surprised to hear that the feat is daily accomplished in less than five days. We rather expect to hear at any moment that it is accomplished in four days or even less. It is a far cry from the chip of wood—the frail bark canoe of the primitive forest races and the hollowed log of the sea islanders, to the majestic and powerful ocean liners of today.

Perhaps the first demonstration of the ability of steam under pressure to furnish motive power, was that given by Hero of Alexandria, who constructed a device known as the "aeolipile," wherein steam was generated in a ball and from the ball discharged through a jet, impinging against the atmosphere and thus making the ball revolve on the axis on which it was mounted. This demonstration is said to have occurred over one hundred years before the beginning of the Christian Era. It was many centuries, however, before any further development of the use of steam as motive power took place. None of the early demonstrations of the ability of steam under pressure to produce motive power had any useful application, and up to the seventeenth century but little progress was made either in the acqui.ement of the knowledge of the properties of steam or in its application to useful purposes.

It seems strange now to think of Hero's early demonstration of the motive power of steam, especially when we recognize in it the fundamental principle of the modern steam turbine which at present is the type of steam engine most conspicuous in many fields.

In the early part of the seventeenth century, about 1610, when the first Stuart to occupy the British throne was struggling to convince people that kings ruled by divine decree, Giovanni Branca, an Italian, invented an apparatus that narrowly missed forming a practical steam turbine. A jet of steam was directed against pallets or vanes on the periphery of a large wheel turning horizontally and transmitting motion to grinding mechanism.

The fatal defect of this steam engine was the absence of attachments to make the steam follow vanes until more of its energy was converted into useful work.

In 1650 there was constructed in England a steam fountain which was employed to raise water to a tank in the top of the tower of Raglan Castle, but steam power first became an acknowledged industrial agent and useful as a prime mover when in 1698 an apparatus, which, however, could not properly be called an engine, although it nevertheless was operated by steam power, was constructed to raise water from mines to secure their drainage.

The first engine, properly so called, was a piece of apparatus with one moving part, patented in 1705 by Newcowmen. It consisted of a steam cylinder and piston actuating a beam above, from the opposite end of which there hung a pump rod operating pumps in the shaft of a mine where it was installed.

Until James Watt had devoted to the steam engine the study which resulted in the improvements that produced the prototype of a modern reciprocating engine, no extensive application of the energy of steam under pressure had been made. Watt invented and introduced many accessories and improvements to his original engine, which was a development of the Newcowmen engine, and after the successful installation of steam engines in the mills and factories of the day, it was long before a type of engine was evolved and combined with a road coach to furnish the motive power for such a vehicle over ordinary highways. One of these, which has come down to us in history, was known as Gurney's steam carriage and was operated in 1828.

The first successful combination of boat and steam engine probably belongs to John Fitch, of Philadelphia, who is said to have operated a ferry on the Delaware River during the summer of 1790. Nevertheless, credit is generally given to Robert Fulton for having been the first to make use of the motive power of the steam engine in his boat, the *Clermont*. August 7, 1807, was the memorable day on which the *Clermont* made its first successful trial trip on the Hudson, and some months later the boat was put into regular service between Albany and New York.

But the need of improved methods of transportation which so long oppressed the human race did not produce the steam engine. The steam engine was evolved through necessity. Its invention was a result of the demand for something to do what neither men nor horses had been able to do. Valuable collieries had to be shut down in England because by the horse-operated pumps then in use, it was not possible to lift water from depths of 500 feet to drain the mines and permit the working of lower levels. Even after the steam engine had been sufficiently developed to operate in connection with a pump, it took a half century of inventive genius to develop it into a motor suitable for driving manufacturing machinery, and still another half century had passed before inventors had seriously begun an attempt to build a steam engine to be used to propel a vehicle on land.

The first actual propulsion by steam on land in the world is said to have been achieved in 1769 when Cugnot, a French soldier, built a steam carriage for moving artillery. This machine, upon trial, was found impracticable as far as its intended object went, although it really ran and is said to have developed a speed of 2½ miles an hour. But we have to go back in our story to 1602, in which year the first rail roadway was constructed in England at a colliery near Newcastle-upon-Tyne. This roadway hardly deserves the name of "railroad," yet it was the progenitor of our present steam highways. It consisted of hard wood stringers grooved on the side or in the center and laid upon crude improvised supports. A horse was the motive power for hauling the crude carts which ran on these "rails." From the date mentioned until 1825, progress in the construction and improvement of rail roadways in Europe was presented by some 27 railways, ranging in length from 4 to 35 miles and a total mileage of about 335. None of these roadways contemplated the transporting of passengers, nor had they such facilities, nor up to this time had a successful steam locomotive appeared.

The story of the early development of the locomotive is of surpassing interest in the history of transportation and will be briefly treated in the succeeding parts of the "Evolution of Transportation."

Items of Personal Interest

Mr. P. S. Fellows has been appointed tool foreman of the Pennsylvania shops at Renovo, Pa.

Mr. Charles Shayne has been appointed roundhouse foreman at the Erie shops at Huntington, Ind.

Mr. E. C. Hause has been appointed general foreman of the Georgia and Florida shops at Douglas, Ga.

Mr. Arthur Squires has been appointed chief mechanical engineer of the Chilean State Railways at Santiago, Chile.

Mr. C. E. Langton has been appointed master mechanic of the Marshall and East Texas, in place of Mr. F. A. Walsh, resigned.

Mr. E. L. Burdick, formerly assistant engineer of tests of the Santa Fe, at Topeka, Kan., has accepted a position with one of the Westinghouse companies.

Mr. J. R. Decker, assistant signal engineer of the Michigan Central at Detroit, Mich., has been appointed division engineer, with office at Bay City, Mich.

Mr. Harry W. Mosley has been appointed assistant general foreman of the repair shops of the Erie at Hornell, N. Y., in place of Mr. H. W. Sasser, transferred.

Mr. I. M. Kilfoyle has been appointed general foreman of the Cotton Belt shops at Tyler, Tex., and Mr. H. Hood succeeds Mr. Kilfoyle as roundhouse foreman at Tyler.

Mr. J. S. Colithon has been appointed master mechanic of the Bellingham Bay and Columbia Railroad, with office at Bellingham, Wash., in place of Mr. J. A. Healy, resigned.

Mr. D. G. Roberts, formerly master smith of the Delaware and Hudson at Oneonto, N. Y., has been appointed to a similar position in the company's new shops at Watervliet, N. Y.

Mr. Thomas Grant, formerly tool foreman of the Delaware and Hudson at Oneonto, N. Y., has been appointed to a similar position in the company's new shops at Watervliet, N. Y.

Mr. F. A. Fairlie has been appointed locomotive superintendent of the Nitrate Railways, Chile, and Mr. J. G. Smith has been appointed assistant locomotive superintendent, both with offices at Iquique, Chile.

Mr. R. O. Rote has been appointed assistant chief engineer of the Lake Shore and Michigan Southern, at Cleveland, Ohio, in place of Mr. G. C. Cleveland, promoted. Mr. H. B. Reinsagen succeeds Mr. Rote.

Mr. J. O. Enockson, formerly roundhouse foreman of the Chicago, St. Paul, Minneapolis and Omaha, at Altoona, Wis., has been appointed master mechanic on the same road, with headquarters at Sioux City, Iowa.

Mr. Alfred M. Darlow, formerly mechanical engineer and general storekeeper of the Buffalo and Susquehanna at Galeton, Pa., has been appointed superintendent of motive power, with office at Galeton, Pa.

Mr. G. D. Brooke, formerly assistant superintendent of the Cumberland division of the Baltimore and Ohio, at Keyser, W. Va., has been appointed superintendent of the Shenandoah division, with office at Winchester, Va.

Mr. M. F. McCarra has been appointed master mechanic in charge of mechanical equipment of the Louisiana Railway and Navigation Company, with office at Shreveport, La., in place of Mr. T. Nicholson, resigned.

W. H. SAUVAGE.

Mr. A. J. Baumbush has been appointed general foreman of the New York Central and Hudson River, with office in New York. He will also have charge of locomotive repairs of the New York, New Haven and Hartford at New York.

Mr. R. Robertson, who has been employed in the mechanical department of the Guayaquil and Quito, in Ecuador, South America, has been appointed superintendent of motive power and floating equipment, with headquarters at Hingra, Ecuador.

Mr. G. I. Evans, formerly mechanical engineer of the Canadian Pacific at the Angus shops, Montreal, Que., has been appointed superintendent of the Augus locomotive shops, in place of Mr. H. Osborne, promoted. Mr. W. H. Winterwood succeeds Mr. Evans.

Mr. W. H. Williams, formerly master mechanic of the Buffalo, Rochester & Pittsburgh at Du Bois, Pa., has been appointed master mechanic of the Buffalo and Rochester division, with office at East Salamanca, N. Y., in place of Mr. P. C. Zang, resigned.

Mr. F. G. Grimshaw, formerly master mechanic of the West Jersey & Seashore and the Canadian terminal division of the Pennsylvania at Camden, N. J., has been appointed assistant engineer of motive power of the Western Pennsylvania division, with office at Pittsburgh, Pa.

Mr. H. H. Althouse, formerly principal assistant engineer of the Erie, has been appointed chief engineer, with office at New York. Mr. Althouse began engineering on the Lehigh Valley, and has been employed on several of the leading Eastern railways, and is an accomplished engineer of wide experience.

Mr. E. J. Brennan has been appointed master mechanic of the Du Bois shops of the Buffalo, Rochester and Pittsburgh. and Mr. J. P. Kendrick has been appointed master mechanic of the Middle and Pittsburgh divisions, with office at Punxsutawney, Pa., and Mr. S. S. Wagar has been apointed chemist and engineer of tests on the same road with office at Du Bois, Pa.

John W. G. Brewer, former master mechanic of the Mount Clare shops of the Baltimore & Ohio Railroad, at Baltimore, has been promoted to the position of superintendent of shops, in charge of locomotive work at that point. Mr. Brewer served his apprenticeship as a machinist in the company's shops at Cumberland, Md., commencing in 1895. In 1908 he was appointed fireman of the machine shops at Mount Clare, and assistant master mechanic in January, 1910, and in April of the same year he was advanced to master mechanic. The shops are the largest on the Baltimore and Ohio system. About 3,000 skilled mechanics and shopmen of various grades are constantly employed there.

Mr. W. H. Sauvage has earned an enviable reputation as an inventor of labor-saving devices, and has met with much success since the Standard Coupler

Company has brought some of his clever inventions into popular use. His automatic shim slack adjuster has just been applied to 500 steel passenger cars on the Pennsylvania Railroad, and a number of the larger electric railway systems have adopted and equipped their cars with the perfected slack adjuster. The Harriman lines have also adopted the device and it is in operation on the entire system. Mr. Sauvage has recently given his attention to other subjects and has successfully introduced appliances improving block signaling, auto train stops in the case of derail, auto governor brake valves to brake trains at 70 per cent. of their weight whether trains are light or loaded. He has also perfected auto train line control valves, and also auto brake cylinder control and accelerating valves, which are elsewhere described in our columns. Altogether Mr. Sauvage has secured no less than 48 patents, nearly all of them in life and labor saving devices, eliminating in every instance the human agency as far as possible. Mr. Sauvage is a native of Ohio, and learned railroad engineering on the Denver & Rio Grande Railroad. He is still in the prime of life and much excellent work in his chosen field may be expected from him.

OBITUARY.

SIR WILLIAM SINCLAIR.

Sir William Sinclair, Professor of Obstetrics and Gynecology in Manchester University, died at his home in Manchester, England, on August 21. Sir William was born at Forfar, in 1846. Shortly after his birth his father, Alexander Sinclair, moved to Laurencekirk, where William received the first part of his education in the parish school. He was for a time pupil teacher in that school and afterwards went to Aberdeen, and gained a bursary in Kings College. Having graduated there with high honors, he entered the medical department of Marschals College, Aberdeen, and graduated from that university with high honors. He acted as resident physician in Aberdeen Royal Infirmary for a time, and then went to Vienna to study obstetrics and gynecology. He afterwards went to Manchester, where he worked into a good medical practice, and became celebrated as a remarkably skillful surgeon. He was the first surgeon to successfully treat cancer in women's diseases. He was in 1888 appointed professor of gynecology and obstetrics in the Victoria University, a position he held to the day of his death. Sir William was a voluminous writer on medical subjects. In 1904 he was knighted by King Edward "for services to medical science." He was a brother of Dr. Angus Sinclair, editor and publisher of Railway and Locomotive Engineering, New York.

Traveling Engineers' Convention

The Traveling Engineers' Association held their Twentieth Annual Convention in the Hotel Sherman, Chicago, August 27-30. The meetings were presided over by the president of the Association, Mr. W. C. Hayes, superintendent of locomotive operation of the Erie Railroad. The proceedings were opened by prayer, after which Mr. S. O. Dunn, Editor of the *Railway Age Gazette* delivered an address dealing principally with the interest of railway employees in efficiency. He assumed that the employees had a right to demand good wages but he wished them to manifest greater inclination to perform their duties efficiently.

We have already published the text of President Hayes's inaugural address, also the historical review of the Association by Secretary Thompson, both of which were most cordially received.

After the preliminary business was disposed of the regular order of business was taken up by the reading of the committee's report on chemically treated water and increased locomotive efficiency.

The chairman of this committee was Mr. Fred. McArdle, who was assisted by Major George Austin, W. S. Reid, W. H. Wallace, Wm. Daze, W. D. Cooper and T. F. Lyons, a strong committee that devoted much painstaking labor to the collection of information concerning the treatment of boiler feed water.

In the absence of the chairman of this committee the report was read by Vice-President F. P. Roesch, Master Mechanic of the El Paso & Southwestern Company. Most of the report was in the form of answers to twenty-three questions sent out by the committee. They are of a very elementary character. The first question: Do you treat feed water in your territory? brought out a most elaborate answer from the Atchison, Topeka & Santa Fe, which embraced elaborate blue prints illustrating water purifying plants.

The committee formulated the answers received as in the answer to question 2. That question reads: State whether your treatment is by the use of treating plants or by using chemicals in the engine tank, or by direct injection through the injector, has the answer: We have considered this question as referring only to water treatment for the prevention of incrustation. We find that in some few cases soda ash is used, applied directly to the tank of the engine, generally in the proportion of about one pound per thousand gallons, this quantity varying as necessity requires. In some cases caustic soda is being used, in lessor proportions on account of its being stronger. We also have knowledge of scientific water treatment, especially prepared to suit the water on any particular division (The Dearborn Drug & Chemical Company's System). All of these meet with some measure of success.

The answer to question 3 brings in a statement issued by the Atchison, Topeka & Santa Fe Railroad, which embraces all the important points made in the report and reads:

"Since the adoption of our water treating system on the Atchison, Topeka & Santa Fe Ry., the mileage of our fireboxes and flues has been doubled and trebled. One of the best examples we have of the benefit of water treatment is the Los Angeles division. In the latter part of 1905, eight large Pacific type, oil-burning passenger locomotives went into service on that division, and up to December, 1907, each of these locomotives had received a new firebox, six of them had received three sets of flues, and the other two, two sets each; the average for all fireboxes being 66,064 miles, the lowest being 62,452, and the highest, 81,608 miles. The average mileage per set of flues during this period was 25,167. There are mountain grades in this territory, on which helpers are used; the work, performed by these engines being in connection with heavy fast passenger service. A very large part of the mileage is one per cent. grade. Shortly after these engines received new fireboxes, or in the latter part of 1907 and the beginning of 1908, a number of water treating plants were installed, and three other plants were installed during 1910, consequently some of the locomotives made considerable mileage with the second firebox before the installation of water treating plants was completed. There are no serious defects in any of those boxes as yet, and they have up to January of this year given an average service of 168,589 miles, and are still going; the flues have given an average service of over 44,000 miles, an increase in flue mileage of 78½ per cent.

Report on Treated Water.

"On the Santa Fe system treated water is used to prevent incrustation, and credit for the prevention of incrustation and improvement in the performance of our fireboxes and flues is given to the system of treating water. An anti-foaming treatment is used to prevent foaming, both in the treated water and in territories where the water is not treated, which does the work very satisfactorily, eliminating all of the troubles due to a foaming boiler, such as wear and tear on valve packing, cylinder packing and machinery, reducing the cost of feul and lubrication and making it possible to handle tonnage that it would be impossible with a foaming condition.

"In territories where the water is not bad enough to warrant the installation of treating plants, but does give trouble from foaming, it is found that anti-foaming preparations have a favorable effect in preventing incrustation as well. It is

but just and fair to a water treatment that counteracts or prevents foaming, to give it credit for adding to the life of the firebox and flues, on the theory that when it prevents foaming it keeps the water in a more dense condition so that it absorbs more readily the heat that is passing through them, and by so doing prevents their overheating and consequent damage."

The committee also referred to a statement from another railroad using a preparation applied directly to engine tanks, where previous to using the treatment the passenger engines made 35,000 and the freight engines 18,000 miles between shoppings, for flues. After the use of the treatment was established, the passenger engines made 85,000 miles, or an increase of 142 per cent. and the freight engines 45,000 miles, an increase of 150 per cent. per set of flues. This report stated that an anti-foaming prepartation was also used.

DISCUSSION.

Dr. Angus Sinclair opened the discussion by voluntary experience with inspection of feed waters on the Burlington, Cedar Rapids & Northern Railway, in the early eighties. He was appointed chemist with supervision of water supply by the management of that railway and found that the water stations had been located without any care being taken as to the character of water procured. He found a case where a well, 200 feet deep, had been sunk on the bank of the Mississippi River, yielding water that contained 47 grains to the gallon of sulphate of lime. The fireboxes of switching engines using this water did not last more than two years. When the pump connections were taken out of the well and put under the river, the trouble from working fireboxes ceased. All the water stations were inspected and surface water substituted for well water when possible with the best results. This was the first systematic attempt made by a railway company to select soft-water for locomotive boiler use.

Mr. A. M. Bickel, Lake Shore, stated that his company had abandoned the use of soda ash as a water purifier in connection with superheater locomotives, because they found that the superheater parts became clogged through the action of the soda ash.

President Worthington at Traveling Engineers' Convention.

An attractive feature of the Traveling Engineers' Conventions is the practice inaugurated by Secretary Thompson, of having prominent railway officials address the convention. At the recent Chicago convention, Mr. B. A. Worthington, the able president of the Chicago & Alton, delivered the following address:

There is no position in the railway service where more effective work can be done than in the position of traveling engineer, and no position that can bring about more economy than from the head end of a train. Very much good can be done on the part of traveling engineers, especially by instructing firemen to properly perform their duties, as the average fireman can save his wages every trip over the road through proper fuel economy.

Much good can be done by instructing the engineers to use careful judgment in starting trains, and in forcing them to speed, and in moving them between stations with as small consumption of fuel as is consistent with necessary speed and time requirements. Also in instructing the engineers in the proper use of the steam in the cylinders. Boiler feeding is quite as important for fuel economy as the right use of steam. While engineers should maintain a nearly steady steam pressure, they should permit liberal variations of the water level within safe limits to have fuel.

Firemen should be instructed that the blowing of pop valves wastes usually about a shovelful of coal per minute, or a lump of coal as large as a lemon every second, and that the avoidance of popping will save considerable of their energy and at the same time save dollars for the company.

Another thing comes to my mind suggestive of how the traveling engineers can do much good, not only for themselves, but for the benefit of their fellow workmen. As is well known, there is prevailing among the laboring classes generally throughout the country a spirit of unrest manifesting itself through strikes of the various crafts and demands for higher compensation, until the employers have reached a state where they find themselves unable to grant further concessions and maintain the solvency of their properties. Yet labor in all lines of service has never been better paid, and the working conditions have never been less arduous in this country than they are at the present time.

In your daily association with men in the service, think of the influence for good which you might exercise if you would but make the effort. Half of the troubles of these men come through ignorance—ignorance which is fostered by various societies and by labor leaders who are supported and aided by newspapers through the dissemination of socialistic literature. In fact, there seems to be a yellow fever of literature prepared for the spread of incorrect information, which is misleading to the men who have not the chance or opportunity to get at the facts to enable them to take a

TRAVELING ENGINEERS' CONVENTION, HOTEL SHERMAN, CHICAGO, ILL.

broader view of things. Soon the men who fall under the baneful influence become unable to distinguish between the right and the wrong. Naturally, they develop a morbid thirst for sensational printed matter, and the more they read the less they learn.

Men in your position who are able to look on both sides of the problem, should speak out plainly and do everything possible that will work as an antidote to those dangerous influences. What I am pleading for is the wider, nobler, unpaid-for service which conservative men are able to render to society, simply by being thoughtful and helping other men to think, thereby exploding wild and impracticable theories and bringing them out to the test of reason, obstinately opposing all rash experiments.

We should not forget that the existence of many of our fellowmen is along dark, confused and bitter lines. Some are groaning under the burden of want, partly because of their own idleness or incapacity, or partly because they are following the socialistic doctrine that they are entitled to a life of ease and pleasure at the expense of somebody else; some because of the greed and injustice of other men; and some because of the lack of proper guidance and of good and human sympathy.

The question naturally arises to each and every one of us as to how best to meet the situation. Manifestly if we take a negative position no good will be accomplished. Our influence, to be felt, must be positive and along unmistakable lines. All reactionary sentiment and false standards should be rebuked by those of us who are able to explain the fallacy of such dangerous doctrines. There is a loftier position than merely to stand high in the world, which can be attained by stooping to help your fellowman to a higher moral plane; by fearlessly pointing out the pathway of truth, purity and righteousness, which will certainly result in the greatest good to the greatest number, and what we need today is a larger number of men who will not hesitate to stand for the right and declare in unmistakable terms their honest convictions against the evils that are at present on all sides, and the wild theories that are being exploited among the laboring classes today, causing so much socialistic unrest and labor trouble.

The traveling engineers could do much good by conservative action, in softening and ameliorating unavoidable inequalities of life which have existed since the world began, and by striving to change the feeling of jealous hatred against the more fortunate ones into a feeling of generous fortitude and hospitality, endeavoring to keep the relation between man and man and between class and class in a healthy condition for the benefit of society as a whole.

If the traveling engineers of the country will work along these lines, much good can be accomplished, and their splendid services in this way will tend to offset the socialistic sentiment which seems to promise to men of limited understanding a life of ease and comfort through legislative enactment and through the coercive forces of union labor, regardless of the frugality, industry and merit of the individual.

Subjects for Next Convention.

"Uniform Instruction to Enginemen on the Handling of Superheater Locomotives."

"The Credit Due to the Operating Department for the Efficient Handling of Trains."

"The Care of Locomotive Brake Equipment at Terminals."

Also papers on:

"Advantages to be Obtained with the Brick Arch in Locomotive Service."

"What Can We Do to Eliminate the Black Smoke Evil in Locomotives Using Bituminous Coal?"

"Scientific Train Loading."

New Officers.

The election of officers resulted as follows: President, W. H. Corbett, M. M., Michigan Central, Michigan City, Ind.; first vice-president, F. B. Roesch, M. M., El Paso & South Western, Douglas, Ariz.; second vice-president, Robert Collett, superintendent locomotive fuel service, St. L. & S. F., Springfield, Mo.; third vice-president, J. C. Petty, traveling engineer, Nashville, C. & St. L., Nashville, Tenn.; secretary, W. O. Thompson, M. C. B., N. Y. C. & H. R., Buffalo, N. Y.; treasurer, C. B. Conger, Grand Rapids, Mich.

The following were elected members of the executive committee to succeed Messrs. Collett, Richardson, McAndrews and Petty: W. C. Hayes, H. F. Henson, Martin Whalen and J. W. Hardy; the latter for one year and the first three for two years.

Chicago was chosen as the next place of meeting, with New York second choice and St. Louis third.

Western Railway Club.

The regular monthly meeting of the Western Railway Club was held in the rooms of the Permanent Exhibit of Railway Supplies, in the Karpen building, Chicago, Ill., on September 17. Mr. G. W. Cravens presented a paper on "The Electrical Equipment of Railway Shops." The monthly meetings of the Club will continue to be held in the Karpen building, which is finely located and admirably adapted for the meetings of engineering societies.

Railroad Notes.

The Erie has ordered 5 mikado locomotives from the Baldwin Locomotive Works.

The Burlington has contracted for 25 mikado locomotives from the Baldwin Works.

The Baltimore and Ohio, has ordered 2,000 box cars from the Cambria Steel Company.

The Pere Marquette has ordered 9,000 tons of rails from the Cambria Steel Company.

The Santa Fe has let contracts for a new roundhouse at Marceline, Mo., to cost $50,000.

The Lehigh Valley has ordered 7 mikado locomotives from the Baldwin Locomotive Works.

The Illinois Southern has ordered 2 mikado locomotives from the Baldwin Locomotive Works.

The Canadian Pacific is in the market for 25 ten-wheel locomotives and 25 Consolidation locomotives.

The Pennsylvania Lines West have ordered 50 locomotives from the American Locomotive Company.

The Lake Shore and Michigan Southern has 20 locomotives from the American Locomotive Company.

The Chicago, Milwaukee and St. Paul has ordered 10,000 tons of rails from the Illinois Steel Company.

The Northern Pacific has ordered 2,500 steel underframes from the Western Steel Car and Foundry Company.

The Canadian Pacific has ordered 125 locomotives of various types from the Montreal Locomotive Works.

The Great Northern has ordered 10 six-cylinder switching locomotives from the Baldwin Locomotive Works.

The Croft Lumber Company has ordered one 60-ton Shay locomotive from the Lima Locomotive Corporation.

The Government railroad of Korea has contracted for 12 ten-wheeled passenger engines from the Baldwin Works.

The San Antonio & Aransas Pass has ordered 10 Consolidation locomotives from the Lima Locomotive Corporation.

The Central Railroad of New Jersey has plans for a steel power house, 90 by 200 feet, to be erected at Jersey City, N. J.

The Pennsylvania is building 26 freight locomotives, 25 switching locomotives and 8 passenger locomotives at its Altoona shops.

The Chicago, Burlington and Quincy has ordered 10 six-wheel switching locomotives from the Baldwin Locomotive Works.

The Louisiana Railway and Navigation Company has ordered 2 Consolidation locomotives from the Baldwin Locomotive Works.

The Chicago, Burlington & Quincy has ordered 10 six-wheel switching locomotives from the Baldwin Locomotive Works.

The Pennsylvania Railroad has contracted for erection of a warehouse at Verona shops, to be 40 by 222 feet and cost $50,000.

The Braden Copper Company, Valparaiso, Chili, has ordered one 40-ton Shay locomotive from the Lima Locomotive Corporation.

The Lehigh & New England R. R. is in the market for five Consolidation (2-8-0) locomotives and one eight-wheel (0-8-0) switching locomotive.

The Southern Brazil Lumber Company, Brazil, South America, has ordered one 70-ton Shay locomotive from the Lima Locomotive Corporation.

The Harriman Lines have ordered 17,000 tons of rails from the Carnegie Steel Company. Of the total, 12,000 tons are for the Southern Pacific, and 5,000 tons are for the Union Pacific.

The Georgia Roads are making plans, it is said, to build from Macon, Ga., west to Waverly Hall, about 70 miles. The Macon Chamber of Commerce and S. W. Hatcher are interested.

The Cincinnati Traction Company, Cincinnati, Ohio, placed an order with the Westinghouse Electric & Mfg. Company for 50 double equipments of No. 318 motors and K-40-A single-end control.

The Grand Trunk has ordered 25 mikado locomotives from the American Locomotive Company. These locomotives, which will have a total weight in working order of 276,000 pounds, will be equipped with superheaters.

The New York, New Haven & Hartford is in the market for 6 ten-wheel lo-

comotives and 4 six-wheel switching locomotives. This company is also in the market for 10 underframes for six-wheel switching locomotives.

The Baltimore & Ohio will expend $200,000 on shop improvements at Garrett, Ind., including new 18-stall engine house 100 feet deep; an oil house 34 by 50 feet; 150 feet cinder pit, gravity coaling station and sand house.

The Peninsular Railway Company of San Jose, Cal., has ordered from the Westinghouse Electric & Mfg. Company two quadruple equipments of No. 333-B2 motors designed for operation on 600-1,200 volt circuits with A-L-F control.

The Westinghouse Electric & Mfg. Company has received an order from the Pacific Electric Company, Los Angeles, Cal., for 45 quadruple equipments of No. 333-B2 motors designed for operation on 600-1,200 volt circuits with A-L-F control.

The Wabash has plans for erecting locomotive shops at Decatur, Ill., and the receivers have issued certificates to the amount of $500,000 for same, though it is understood that the plant will eventually cost $750,000 when completed.

It is expected that the Denver & Rio Grande will shortly place contracts for a considerable amount of betterment work. This work includes double tracks between Castle Gate and Kyune and between Tucker and Thistle, a distance of 20 miles.

The Colorado & Southern is to carry on improvements on the line from Orin Junction, Wyo., which includes replacing 56-lb. rail with 85-lb. rail on 35 miles and constructing a four-stall temporary engine house and a 50-ton coal chute at Hartville Junction.

The Chicago, Burlington & Quincy R. R. has placed an order with the Baldwin Locomotive Works for 25 mikado (2-8-2) locomotives. This is in addition to the order for a like number reported last month, making a total of 50 recently ordered.

The Rochester Railway & Light Company, Rochester, N. Y., for one 3-unit, 4-bearing motor-generator set consisting of one 145 K.w., 120-volt D. C. generator; also one 45 K.w., 80-volt D. C. generator driven by one 285 h. p., 4,150-volt, 3-phase, 60-cycle, 900 r. p. m. synchronous motor.

The Georgia Southwestern & Gulf expects to begin work on an extension next fall from Albany southwest to St. Andrews, Fla., and contracts are tentatively let for the work. There will be one steel bridge, 400 ft. long, and two 60-ft. spans. W. M. Legg, president and general manager, Albany.

The Minneapolis, St. Paul & Sault Ste. Marie has ordered 10 Consolidation locomotives from the American Locomotive Company. The dimensions of the cylinders will be 25 ins. x 30 ins.; the diameter of the driving wheels will be 63 ins., and the total weight in working order will be 225,000 lbs.

The Georgia Coast & Piedmont has started work on the extension of its line from Darien to Brunswick, Ga. The work was started from Darien, Ga., and considerable headway has been made in clearing the right of way leading from the McIntosh county seat to the Altamaha river, where the road will cross a trestle and enter Glynn county.

The Buffalo, Rochester & Pittsburg Ry. has ordered one Pacific passenger locomotive, with 24½ x 26-in. cylinders, driving wheels 73 ins. in diameter, and a total weight of 258,000 lbs. in working order, and nine mikado locomotives with 26½ x 30-in. cylinders, driving wheels 63 ins in diameter, and a total weight of 275,000 lbs. in working order from the American Locomotive Co.

Among recent orders received by the Westinghouse Electric & Manufacturing Company are the following: Oakland, Antioch & Eastern Railroad Company, San Francisco, Cal., for two 750 K.w., 1,300-volt D. C. 1,080 h. p., 11,000-volt A. C., 3-phase, 60-cycle, 514 r. p. m. 3-bearing synchronous motor-generator sets, together with two 5-panel switchboards for the control of same.

The Denver & Rio Grande R. R., it is reported, will build a branch line up Little Cottonwood canyon beyond Wasatch so that in addition to transporting the ores from the mining camp of Alta, situated at the head of the canyon, it will be enabled to freight stone from the granite quarries in the canyon. It is said that the line will be a benefit to the mining district and many deposits of ore will be worked that are untouched now because of poor transportation.

The increase of approximately $500,000 in Missouri Pacific's gross earnings for the last week of July made the stock stronger than it has been for some weeks. The earnings shown are an indication of the tonnage existing in Missouri Pacific territory, of which the Gould road is now getting its proper proportion and moving on an economical basis.

The company shows a deficit for the year after charges of $2,100,000 against a deficit last year of $5,232,539.

Books, Bulletins and Catalogues

Baldwin Record.

The Baldwin Locomotive Works' Record No. 72, which has just been issued, is more than usually interesting from the fact that it contains the latest and most complete details of the Mallet articulated locomotives yet published. The illustrations are in the best style of the illustrator's art, and the phantom method of showing the inner details of construction are, in the publication, carried to the limit of perfection. An interesting treatise in the handling of this type of locomotive is also given, together with detailed descriptions of a large number of various types of the Mallet articulated locomotive with photographic and detail illustrations. The Record extends to 44 pages, and copies may be had on application addressed to the company's office, Philadelphia, Pa.

Vanadium.

American Vanadium Facts appear in improved form from month to month and presents in a terse and interesting way the facts in regard to the growing use of vanadium cast steel in locomotive and other construction work. As a sample, it may be stated that the first locomotive frame made of this kind of steel was put in service in the Pittsburgh & Lake Erie and the Vandalia railroads about five years ago. At the present date there are nearly 6,000 vanadium cast steel frames in service. They are already standard on a number of the large railroad systems in the country. It appears also that the Chrome-Vanadium steel driving tires are coming rapidly into favor, one large railroad reporting a mileage of 121,000 miles without turning. Copies of the company's publications may be had on application at the company's main office, Vanadium Building, Pittsburgh, Pa.

Graphite.

Dixon's graphite publications are sent free on request addressed to the Joseph Dixon Crucible Company, Jersey City, N. J., and they always contain a mass of interesting information not only in regard to graphite as a lubricant, the merits of which are well known, but other details in regard to the use of graphite. The current issue tells all about graphite as a preventive of scale and corrosion in boilers. Particulars are also given in regard to silica-graphite paint, which protects steel work. The long service records of this protective paint is remarkable, and it appears that it is now not only used on metals, but is rapidly gaining favor in greenhouses and other buildings that have been subject to rapid deterioration, but have assurance of longer life when protected by Dixon's silica-graphite paint

Osborne Valves and Joints.

The fine products of the Osborne Valve and Joint Company, Rookery, Chicago, Ill., are coming prominently into notice. The "Nokut" valves, so-called on account of the valve and seat never showing any tendency to cut, is receiving a high meed of praise from all who have had the opportunity of testing the merits of the valve. The seats are protected by a clever device in the form of an extended piston that projects itself into the opening below the valve seat, and acts as a protector, holding back the flow from beneath, and greatly reduces the pressure or velocity across the seats. The outlet between the seats is so much greater than the inlet between the seat ring and protector that the wear almost entirely comes upon the protector leaving the seats unharmed. The effect is the same in both closing and shutting. The parts are readily removable. The avoidance of sudden pressures on the bearing is entirely avoided. At a low estimate it is claimed that they will last twice as long as any other valve.

The company's pipe joints also bring out a new principle obviating the making of the joint on the thread of the pipe or between the two faces of the flanges. The joint is made between a union ring and the pipe ends by the compression of a wedge-shaped packing, making a continuous metal casing. The threads merely hold the parts together, and the tightening of the joint is effected by tightening the adjustable bolts. Those interested in these economical devices on valves and joints should send for catalogue.

Freight Terminal and Trains.

Mr. John A. Droege, superintendent, Providence Division, New York, New Haven & Hartford, author of a popular book on "Yards and Terminals," which was published several years ago, has revised and greatly enlarged the work, and it has just been published by the McGraw-Hill Book Company, New York. It forms a handsome volume of 465 pages, profusely illustrated and substantially bound. The volume is an exhaustive treatise on freight transportation in all its details. The planning, building and maintaining the various plants in connection with freight terminals are fully and clearly described and illustrated. The mechanical department also receives consideration, and, in brief, there is no detail lacking to make the work a standard authority on the subject, and one which should readily receive the endorsement of all who have the good sense to secure a copy of the latest and most comprehensive book on the subjects of which it treats. In the department of engine coaling plants it contains a mass of information hitherto not found in any pub-

lication. The same may be said of the attention given to ash and sand plants. There is also very interesting chapters on the engine house and engine house foreman, and altogether the work is a valuable addition to railroad literature. The price is five dollars.

Lubricators.

The Detroit Lubricating Company has just issued Catalogue No. 35. The work extends to 232 pages and is profusely illustrated. As is well known the company's products are standard throughout the world. Among the more recent improvements in lubricators the sight feed, ten pint capacity lubricator is already meeting with much favor on the largest types of locomotives. The company's other products, including Four feed oilers, Radiator valves, spring compression grease cups and self-cleaning water gauges are all fully described and illustrated in the new catalogue. A dozen pages are devoted to general instructions for installation of these and other mechanical appliances. Copies of the catalogue may be had on application at the company's main office, Detroit, Mich.

Ajax Babbitt.

An illuminated folder has just been issued by the Ajax Metal Company, Philadelphia, Pa., describing a special brand of Babbitt Metal made exclusively by that Company. The metal is designed for general purposes and answers in ninety-nine cases out of a hundred where genuine Babbitt is now being largely used. In many cases it is claimed to do better service than the so-called genuine article, and it costs about half the price. It is coming rapidly into favor and except in cases of extremely heavy loads it is giving complete satisfaction. It is known as the Ajax Bull Babbitt, and only needs a trial to convince the most sceptical as to its durability and economy. Send for particulars to the company's main office, Philadelphia, Pa.

An Erie Station Agent School.

The Erie Railroad Company has in operation in Elmira, N. Y., the most complete school in the United States, under the guidance of railway officials devoted exclusively to training students to fill positions of station agents, telegraph operators for the railway service. Mr. C. P. Utley is manager and Mr. L. J. Baird chief instructor. Miss Katherine L. Utley, a graduate of Syracuse University, gives instruction in typewriting, penmanship and rudimental mathematics.

At the Antiquary's Shop.

"I am commissioned, monsieur, to buy a Louis XIV console; have you one?"

"No. I have one that is a Louis XVI."

"Oh, that will answer, I am buying for a rich American. A matter of two Louis is nothing to him."

The Only Escape.

Golfer (to excited pedestrian, who has already been driven into by a couple coming in opposite directions)—Fore!

Excited Pedestrian—Orl right, guv'nor! You ain't got a rabbit burrow 'andy, 'ave yer?—Punch.

Helped Some.

"Yes," said the returned hunter, "I had a narrow escape from a rhinoceros."

"And what saved you?"

"The fact that the rhinoceros could not climb a tree had something to do with it," responded the hunter, modestly.

The High Cost of Living.

A grouchy butcher, who had watched the price of porterhouse steak climb the ladder of fame, was deep in the throes of an unusually bad grouch when a would-be customer, 8 years old, approached him and handed him a penny.

"Please, mister, I want a cent's worth of sausage."

Turning on the youngster with a growl, he let forth this burst of good salesmanship:

"Go smell o' the hook."

A Frank Confession.

An ex-convict who was a candidate for the position of prosecuting attorney of Oklahoma County, Oklahoma, made the following plea for the support of the electors: "When I was a train robber, I was a first-class train robber, and if you choose me as prosecuting attorney, I shall make a good prosecuting attorney." The people took the man at his word and he was elected to the office sought by a large majority.

Not Till Afterwards.

"Do you mean to tell me that such a physical wreck as that gave you such a black eye?" asked the magistrate. "Sure your honor, he wasn't a physical wreck till after he gave me the black eye," replied the complaining wife.

Progress means quick movement, and it never was so rapid as it has been in 1912. Never were truer the words of Carlyle: "The race of life has become intense. The runners are treading upon each other's heels. Woe be to him who stops to tie his shoestrings."

There is nothing that this age, from whatever standpoint we survey it, needs more, physically, intellectually, and morally, than thorough ventilation.

Railway Signal Association.

The seventeenth annual convention of the Railway Signal Association will be held at Quebec, October 8-9-10. The headquarters will be at Chateau Frontenac. Nine Committees are expected to report on the various subjects submitted to them, and the proceedings are expected to be of an unusually interesting kind.

A Lesson in Courtesy.

"When Stuyvesant Fish was president of the Illinois Central Railroad, he was sitting in his office one morning with the door closed, looking over some reports. The door was suddenly opened and in came an Irishman with his hat on his head and his pipe in his mouth, and, walking up to Mr. Fish, he said: 'I want a pass to St. Louis.'

"President Fish, somewhat surprised, looked up and said, 'Who are you?'

"The man replied, 'I am Pat Casey, one of your switchmen.'

"President Fish, thinking it was a good chance to teach the man a little lesson in etiquette, said: 'Now, Pat, I am not going to say that I will refuse your request, but there are certain forms that a man should observe in asking a favor. You should knock at the door before you come in, and when I say 'Come in,' you should enter, and, taking off your hat, and removing your pipe from your mouth, you should say, 'Are you President Fish?' I would say, 'I am. Who are you?' Then you should say, 'I am Pat Casey, one of your switchmen.' Then I would say, 'What can I do for you?' Then you would tell me, and the matter would be settled. Now, you go out and come in again in a little while and see if you can do better."

"So the switchman went out, closing the door. About two hours later there was a knock on the door and President Fish said, 'Come in.' In came Pat Casey, with his hat off and his pipe out of his mouth. Pat said, 'Good mornin,' are you President Fish of the Illinois Central?' President Fish said, 'I am. Who are you?' 'I am Pat Casey, one of your switchmen.' 'Well, Mr Casey, what can I do for you?' 'You can go to h——. I got a pass over the Wabash.'"

When Mr. B. A. Worthington went to be general manager of the Oregon Short Line, he walked past the cinder pit one day, and saw an engine equipped with a Walschaerts valve motion, the first of the kind he had seen. A man was working on the tender truck, who happened to be a car repairer. Mr. W., thinking it was the engineer, asked what kind of a valve motion that was, and the man shouted to the engineer, "Come here quick, Jim; here's the new General Manager wanting to know something about railroading."

A Model Plant.

The new factory of the United States Light and Heating Company at Niagara Falls, N. Y., or to be exact, at Suspension Bridge, N. Y., is not only a model of its kind, but is particularly worthy of favorable mention.

This plant is today over 100 per cent. larger than only a few short years ago, and yet it is not ill shapen and "mixed up" as is usually the case when rapid progress prevails. On the contrary the factory shows forethought and careful business methods and altogether the culmination of united effort by an efficient management.

Consider that this is the first plant ever built expressly for the manufacture of Axle Lighting devices and is the largest in the world of its kind.

The equipment throughout is the most modern and efficient that money will procure, and a great many new and novel features are prominent both in building construction as well as machinery.

Concrete construction prevails, the supporting centers being pillars of the mushroom type. The counter shafts are hung by means of bolts inserted in ceiling plates or "button-holes," these latter being embedded in the cement, thus allowing for the changing or adjusting of overhead machinery as often as desired without cutting. This form of hanging counters, etc., cannot be too highly spoken of, as it not only is obviously an economic measure, but one which is a wonderful time saver.

The devices made by this company are too well known to need any comment, but their new Panel Board is deserving of special praise on account of the new features embodied.

This Panel Board or Regulator as it might properly be called is really the heart of the U. S. Light, for of what use is the system without the controlling pulse.

The Panel Board is in brief a solinoid control which when the battery approaches "full charge" throws in a potential relay which cuts down the temporary high voltage and thus by means of these balancing elements a "floating" voltage is maintained.

By the use of this panel not only is the mechanical effort lessened, but whether a greater or less duty be required of the current, at varying speeds, or even should a break occur in the battery circuit, a constant and steady light is assured.

The company has also devised and put upon the market a new electric starter for automobiles, which is undoubtedly destined to come rapidly into general use in that field.

We pray to be conventional. But the wary Heaven takes care you shall not be, if there is anything good in you.

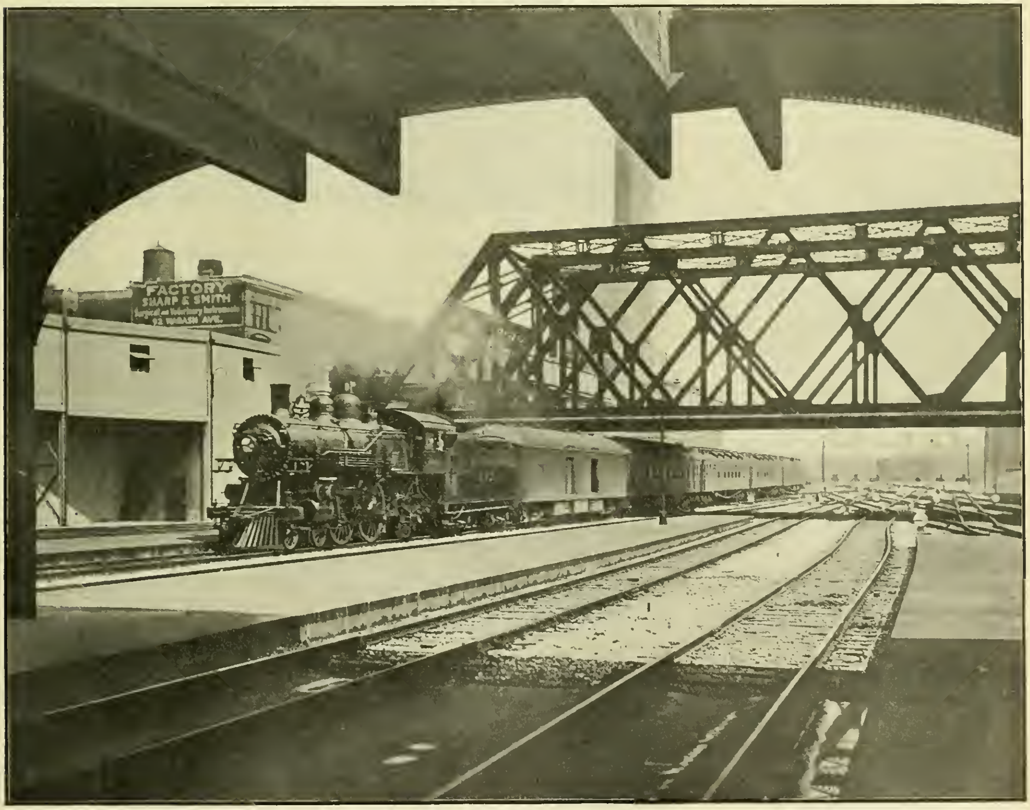
Good character is above all things else.

Railway and Locomotive Engineering
A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXV. 114 Liberty Street, New York, November, 1912. No. 11

On the Chicago & Northwestern.

It will be universally admitted that Chicago is the center of the railroad world today, receiving as it does the multitudinous streams of commerce bearing the industrial triumphs of eastern manufactories, as well as the agricultural and mineral wealth of the ever expanding west. As it was said in the palmy days of the Roman Empire—all roads lead to Rome—it may be said with equal truth that all roads lead to Chicago, and while it would be invidious to make comparisons between the extent of mileage in use and the number of locomotives engaged on the leading roads, the Chicago & Northwestern easily takes its place in the front rank of the great western highways, reaching, as it does, with its network of branches over an extent of eight thousand miles through the richest portions of the west and northwest.



TRAIN ENTERING NEW PASSENGER TERMINAL, CHICAGO. CHICAGO & NORTH WESTERN RAILWAY.

It would be idle to attempt in our necessarily brief article, a detailed description of the numerous and interesting routes which the traveler in quest of business or pleasure could take over this great road, all of them full of interest both in the marvel of expanding cities that cluster along the highway as well as in the scenic splendors which are such a marked feature of the new and ever-marvelous country. It should be remembered that The North Western Line was the first railway from Chicago to the north and west; and the relationship between the growth of the city, the railway and the upper valley of the Mississippi has been very close indeed.

Three hundred passenger trains per day arrive at and depart from the Wells Street Station via The North Western Line,

over three main lines that diverge just beyond the station, one extending directly west to Omaha and points in Iowa, Nebraska, Wyoming, South Dakota, Colorado and the Pacific Coast; another to the north, skirting the shore of Lake Michigan, to Milwaukee and all points in eastern Wisconsin and the Upper Peninsula of Michigan; and a third line extending in a northwesterly direction to St. Paul, Minneapolis and Duluth. This magnificent double-track highway passes through one of Chicago's busiest manufacturing centers, and farther on through a chain of handsome suburban towns, after which the country is interspersed with a chain of towns, with rich farming lands between, varied with timbered knolls and rich meadows until Madison, the capital city of Wisconsin, is reached, which is generally conceded to be one of the most beautifully situated cities in the west. It is located upon a series of gradually sloping hills between Lake Mendota and Lake Monona, which form part of a chain of five lakes, the others being Kegonsa, Waubesa, and Wingra. Macadamized roads lead through shaded dells, over beautiful hills or winding along the shores of the lakes, affording charming drives; continuing the journey through a country ever growing in interest and wealth, the road curving around the base of the dark hills, the train crosses the Wisconsin, a river which, 500 miles in length, presents features that vary from the grandeur of the Hudson to the weird grotesqueness of the Colorado canyons. It is the largest and most interesting river in the state, as well as one of the most beautiful in the west.

Indeed the eye is never wearied and presently the twin cities of St. Paul and Minneapolis is reached, 418 miles from Chicago. The two cities are ten miles apart, but they seem to be together, as the space between is built up so closely. They are also separated by two rivers, St. Paul being situated on the north bank of the Mississippi river, below the mouth of the Minnesota, and Minneapolis on the opposite bank, above the mouth of the Minnesota. The road crosses a beautiful stone arch bridge before entering Minneapolis, from which one of the most beautiful and interesting views of the upper Mississippi may be had. The Falls of St. Anthony are in view, and at no great distance are the Minnehaha Falls, of surpassing beauty, and rendered famous by the genius of the poet Longfellow.

By doubling back a short distance one can reach the important branch that leads to Duluth, passing through a rich lumber and mineral country, the rich outcropping of the northwestern copper fields. The City of Duluth has a magnificent appearance rising, as it does, on the high bluffs overlooking Lake Superior. The line to Duluth extends across St. Louis Bay, which, together with St. Louis River, forms the boundary line between Wisconsin and Minnesota. As the bay is crossed Lake Superior can be seen to the right, beyond Minnesota point, the narrow strip of land extending several miles across the head of the lake, which, with Wisconsin Point, forms one of the best sheltered harbors on the Great Lakes. The shipments of grain reach about 100,000,000 bushels annually, two-thirds of which is wheat. These figures serve to indicate to what extent Duluth serves the great Northwest as a market for its enormous products.

Duluth has large capital invested in flouring mills, the annual shipment of flour amounting to 3,000,000 barrels. The manufacture of lumber and the shipments of iron ore are both on a large scale. Nine railroads terminate here, which, with the lake, make Duluth's shipping facilities unsurpassed. The site of the city is most beautiful and commanding, and by the nature of its location and surroundings Duluth is a natural gateway to the wonderful iron district of the Mesabe and Vermilion ranges, and to the great North Woods.

Of the other branches of the great road, that which crosses Illinois and Iowa, between Chicago on the east and the Missouri river at Council Bluffs, and Omaha on the west, passes through broad and fertile plains where farmsteads vie in agricultural wealth with the products of magnificent manufacturing centers such as Geneva, De Kalb, Rochelle, Dixon and Sterling. It will be remembered that the completion of this branch to Council Bluffs in 1867 formed the first means of through rail communication between the Atlantic and the Pacific. Indeed the rapid development of the West, the commercial invasion of the Far East, the annexation of dominions in the Pacific has been owing in a great measure to the westward movement of emigration and occupation made possible by railroad development. Over the branch referred to there are five daily passenger trains passing through from Chicago to the Pacific Coast, one of which is known as the Overland Limited, and is generally admitted to be the most luxurious train in the world. Every year has seen progress in the matter of shortening the schedules, reducing grades, improving the motive power, with the result that the traveler finds himself surrounded in the remotest west with the comforts that were formerly confined to the east.

PALATIAL NEW PASSENGER TERMINAL, CHICAGO.
CHICAGO & NORTH WESTERN RAILWAY.

Of the other important branches we cannot at present enter into details, but it may be added that the Chicago & Northwestern system was the pioneer into the Black Hills, and the first to touch their wealth and open their beauties to the eastern world. The building of The North Western Line into this region in 1886 opened up to immediate development the large ore bodies that waited only for transportation facilities to make them profitable, and at the same time made available a large area of grazing country and provided access to more than 40,000,000 acres of farm land in South Dakota and throughout the Black Hills; providing markets for the cattle-grazing districts and giving this industry an impetus the effect of which is greater today than ever before in the history of the region.

West of the Black Hills, The North Western Line extends across Northwest Nebraska to Casper, Wyo., and the Wyoming & North Western Railway extends from Casper west across the state of Wyoming to Shoshoni and Lander, opening up the region that is now one of the most important grazing grounds in the world

and from which thousands of sheep and cattle and great quantities of wool are shipped yearly.

In Wyoming and other states, what was formerly a pathless desert is now the scene of a rapidly expanding system of dry farming, and as the area of tillable lands in the United States is becoming comparatively small this new and successful method will engage the attention of the enterprising agriculturist who is disposed to take advantage of the liberal Homestead laws and who will find that regions are already opened up by the Chicago and Northwestern that will provide homes for millions in the near future.

Among other progressive movements made by the active minds engaged on the railway a system of fire extinguishing appliances has been introduced with marked success. Locomotives are in readiness at various points equipped with fire hose and tank cars. The locomotives furnish steam to operate the pumps. The apparatus was tested recently for the Wisconsin State Fair Department with marked success. At 85 pounds water pressure, an effective fire stream was thrown 100 feet with such force as to require the best efforts of two men to control the nozzle. With this a fire in the timber country can be gotten under control in an hour or two, and thousands of dollars' worth of property, both of the railway company and of the farmers whose property is near enough to be reached by the apparatus, has been saved by this invention of an experienced fire fighter.

from that feeling of kindly kinship with the rank and file. An unusual record for immunity against engine failures is constantly reported by the operating department. As an instance the western Iowa division reported in one month there were in service 73 locomotives making a total mileage of over 150,000 miles. During the entire month, however, there was not one engine failure of any nature, no delay to passenger trains on account of locomotive conditions, not an hour's delay in switching service and not a car set out in the freight train service.

This record, says the management, is due to an increasing disposition on the part of the men to take some such pride in their work as marked the old days of railroading. As an example of this one incident is taken as indicating the desire on the part of the trainmen to make a good record. On the locomotive hauling an important passenger train the air apparatus opening the fire-box doors became out of order, which made it possible to pass the fuel into the fire-box through one of the doors only, rendering it impossible to use the shovel.

By the ingenuity of firemen and engineer the locomotive was fired by hand in this way and the train arrived on schedule time at the terminal, enabling the division to retain a perfect record.

This is as it should be, and we trust that the kindly relations thus briefly referred to will not only long exist, but that they will become an example to others, proving that the interests of all engaged

THE SAN FRANCISCO OVERLAND LIMITED, CHICAGO & NORTH WESTERN RAILWAY.

We cannot close without referring briefly to the kindly relations that have always existed between the employees of the Chicago & Northwestern and the officials. Many of the latter have grown up with the great highway and their success has apparently not separated them in railroad work are co-ordinate and identical.

Chilean Railways.

There is much talk of reorganizing the Chilean Government railways and putting them on a better business basis, which means that a large amount of rolling stock must be purchased within the next year or two. The Government railways have been unable to handle the rapidly-growing business owing to a shortage of cars and motive power. Since 1906 the tonnage handled has almost doubled.

Electrification of French Railway.

For some time past the French State Railway authorities have been conducting electrification experiments on a stretch of the Western Railway, and it is stated that results have been so satisfactory that it has been decided to go into the matter on a larger scale. Contracts for 100 electric locomotives have just been placed with French and Belgian builders.

More Erie Equipment.

Owing to the retirement of W. J. Harahan from the Erie as a vice-president, George M. Orcutt has been made assistant to the president, and H. A. Taylor, commercial counsel, becomes attorney in place of Mr. Orcutt.

The directors have authorized an equipment trust of $4,000,000 to provide for requirements for the last of the present fiscal year and the first half of next year. This covers equipment under construction and to be contracted for within the next twelve months.

Railways to Execute Territory Work.

The people of Canada are much more inclined to recognize the engineering ability employed by railway companies than the politicians that rule public affairs in the United States. The government of Saskatchewan wanted to carry out a stupendous enterprise schemed for the benefit of the territory. It was no less an enterprise than diverting the South Saskatchewan River to supply water to Regina, Moose Jaw, Weyburn and other places and also in developing 30,000 electrical horse power. When it was decided to go on with this great work the operations were put into the hands of the Canadian Pacific and the Grand Trunk railways. The engineers of these companies are now engaged in preparing the necessary plans.

Canadian Railway Statistics.

Official data show increase in the railway mileage of Canada for the fiscal year ended June 30, 1911, to have been 669 miles, against 627 miles in 1910 and 1,138 miles in 1909. Seventy per cent. of the increase in the fiscal year 1911 was in the western provinces. The total railway mileage in actual operation in the Dominion on June 30, 1911, was 25,400, as compared with 24,731 in 1910 and 24,104 in 1909. There were in addition 1,577½ miles of railway in actual operation, but officially regarded as still under construction.

General Correspondence

Improved Locomotive Tank.

Editor:

I have just secured a patent for an improved locomotive tank. The chief feature is a circular coal pocket having doors in the side. It is mounted over the water tank, and is pivoted in the center. It is loaded in the usual way, but the circular coal pocket is inclined forward and the greatest amount of coal is always nearest the fireman, that being the lowest point. In service, a brake is tightened by the fireman near the bottom of the pocket to keep it from rotating. The door nearest the fireman is raised, and when the coal in that particular section is used the door is dropped and the brake released when the pocket will revolve and bring the greatest amount of coal to the bottom and nearest to the fireman. It will carry more coal and water than the ordinary tank.

Heretofore the fireman had to shovel more than half of the coal twice before it reached the fire, but with this type of tender as long as there is coal in the pocket the fireman can reach it easily. It works entirely by its own weight, and saves much of the hardest kind of work, and would be a great saving especially on the larger kinds of locomotives.

Fitchburg, Mass. WILLIAM HEINIG.

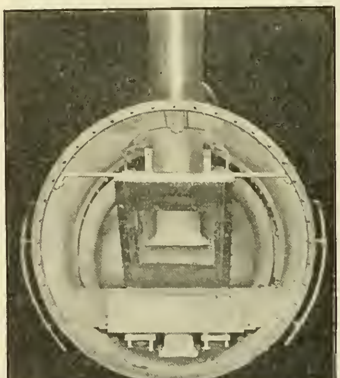
The Slater Locomotive Spark Arrester.

Editor:

About two years ago, some tests were made on the Chicago and North Western Railway with a new style spark arresting device that has since been patented by Mr. F. Slater, master mechanic of that railroad. These tests were made between Green Bay and Oshkosh and, as the Chief Forester of Wisconsin, Mr. Griffith, was interested in the reduction of fires due to sparks being thrown from the locomotive stack, particularly in the densely wooded section of the State, he was invited with Prof. Mack of Wisconsin University, to take part and witness tests.

A 4-6-0 engine fitted with the device was put on a heavy freight train which had a way car attached, next the tender for observation purposes, Messrs. Griffith, Mack and others sitting in cupola; a road foreman was on the engine with instructions to see that everything was done to emit the greatest number of sparks and at times engine was abused in the effort to do so. During this trip, which took place on a dark night, only 22 live sparks were seen in the 58-mile run, none of these reached the ground alive. The results obtained were so satisfactory that orders were immediately given to equip all engines on the C. & N. W. Ry. with the device, the understanding being that engines in Wisconsin and Michigan must have the preference on account of the conditions in these States where we run through heavily wooded country, and, therefore, greater liability of fire during dry weather. There are more than 1,200 engines equipped and the claims account fires have been reduced nearly 50 per cent., and it is believed that when all engines are fitted up, a fire caused from sparks from smoke stack will be a thing of the past.

In construction the apparatus looks



SLATER SPARK ARRESTER.

like an irregular shaped box, the two sides and front being of perforated steel plate, while the top, bottom and back, is made of sheet steel.

With Master Mechanics' style of front end, considerable difficulty has always been experienced in fitting the netting around sides of smokebox on to angle iron so as to insure its being spark proof; the same thing applying to plates around steam pipes, but with the Slater box front end, there is no such trouble, as all sheets can be made to templet and accurately fitted to box without any possibility of an opening larger than the mesh of netting and, as no fitting is necessary around steam pipes, this possible cause of spark emission, improperly fitted or warped plates, is overcome.

Another thing that appeals to the master mechanic, round house foreman and others interested in keeping front ends in proper condition, is the ease of inspection. A man can with this device get in front end and examine all around box without disturbing anything and then know exact condition of same.

Where fire suits are brought against railway companies often-times without justification, it is a difficult matter to take old style netting out and produce it in court as it was in the engine, for the process of taking it apart would so disarrange it that the ordinary jury could not be convinced that while in place it was spark proof, but with the box front end described, it is possible to remove it bodily after taking front door frame off and produce it in court just as it was in the engine so that no question could be raised as to its condition.

The cost of equipping engine with this arrangement is no greater than with the Master Mechanics' front end; in fact, after templets are once made, it costs less. H. T. BENTLEY,

Asst. Supt. Motive Power and Machinery.

Chicago and Northwestern Railway, Chicago, Ill.

Monthly Lectures.

Editor:

One of the progressive movements on the Cincinnati, Hamilton & Dayton Railway, and, which promises the best results, are the monthly meetings where lectures on locomotive operation and fuel economy are being delivered to engineers and firemen. The principal lecturers are Mr. C. A. Gill, master mechanic; Mr. R. H. Wallace, supervisor mechanical operation of engines; and Mr. M. P. Hoban, road foreman of engines. The lectures are creating the liveliest interest among the railway men, and an excellent feature of the proceedings is the opportunity given of asking questions on the various subjects treated of. In this way many valuable suggestions have been already received, and much will undoubtedly be accomplished in the way of betterment of service and economy in operation. A marked improvement has already been reported in the matter of fuel economy, and the future is full of promise. Mr. A. P. Pendergast, superintendent of motive power, has shown the warmest appreciation of the keen interest taken in the lectures by the

engineers and firemen, and every encouragement is offered to draw out opinions from the railway men engaged in the mechanical department with a view to a thorough knowledge of the important work in which they are engaged. J. S. Roberts.

Cincinnati, Ohio.

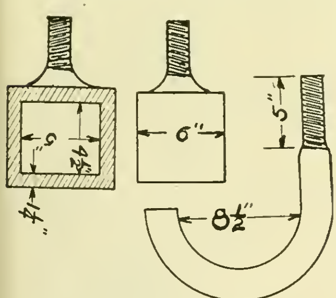
Applying and Removing Wheels for Tire Turning.

Editor:

In a number of railroad shops one can find various devices for putting wheels in wheel lathe and removing same. Some of these are labor saving devices and quite a number are not.

We have used a simple arrangement that is very satisfactory, inexpensive, and requires no attention to keep in condition. The only thing needed to begin with is to have your lathe so it can be reversed. If you have a motor that is reversible, all right; if not, fix up a belt to run the lathe backwards. Then get two pieces of rail about four feet long that will go into the slots of the lathe, and a longer piece that will reach from one face plate to the other. Arrange a hook with turnbuckle on it to fit over the rail and also to take the axle of the wheels. After this is done you are ready to place your wheels, and all you have to do is to roll your wheels where they can be caught by the hooks and start the machine going, and they are lifted into place in a second.

When the tires have been turned put the appliance into place again and reverse the machine and the wheels are



DEVICE FOR TIRE TURNING.

placed back on the floor. One man can operate this, and it is a very small job for two men to roll the wheels and put them in and tighten centers.

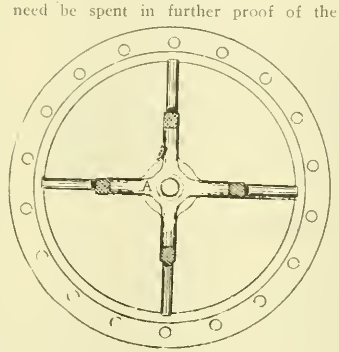
The cost is very small, and this rig is about as efficient as a crane where there are not a great number of wheels to be turned, and the upkeep cost is nothing.

Atlanta, Ga. R. S. Booth.

Setting Guides and Cross-Heads.

Editor:

Enclosed are sketches showing a home-made device for quick use in setting the locomotive crosshead guide bars. A is the center expander adjusted in the cylinder center in the front end of cylinder, and can be readily proved to be in the center by calipers or otherwise. B shows a tapering attachment, or cone, pressed as far as possible in the stuffing box in back end of cylinder. If the stuffing box is clean the cone is unerring in regard to the exact central position, and no time need be spent in further proof of the



CENTER EXPANDER IN CYLINDER.

exact central location of the extending shaft. As is well known, a string is not only difficult of adjustment, but its flexibility is an abiding drawback to its reliability. With the device described, the best results may be obtained both in the perpendicular and horizontal adjustment of the guide bars. The dimensions of the parts of the device, of course, may be such as are readily adaptable to the sizes of the cylinders, but adjustable threaded ends on the front end appliance may readily give a range varying in several inches of diameters of cylinders.

Montreal, Canada. J. G. Koppell.

Locomotive Tests on Lackawanna.

Editor:

A saving of from 29 per cent. to 32 per cent. in coal and 27 per cent. in water per ton-mile in freight service has been effected on the Delaware, Lackawanna & Western by the introduction of a heavy and powerful class of Mikado locomotives of the latest design in place of consolidation locomotives of a straight forward conventional design. This is shown by the results of comparative road tests between the new Mikados built for this company by the American Locomotive Company, and consolidation locomotives previously used in the same service and purchased last year from the same builders.

As a result of their great economy, the Mikados, though 32 per cent. heavier and much more powerful than the consolidations burn 21 per cent., or from 2 to 3 tons less coal per trip than the latter, and yet haul 14 per cent. heavier trains at the same or higher speeds.

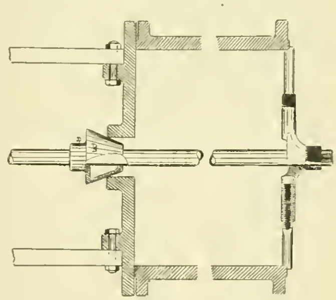
The trials were in no sense a scientific test to determine the relative efficiency of the two designs. The object was merely to compare the performance of the two classes of locomotives with respect to fuel and water consumed and load and speed in the same service and under average operating conditions, with a view to determining just what average benefits, if any, the Mikados effected in handling the traffic.

All observations were made on the Buffalo division between Elmira and East Buffalo, a distance of 141 miles. Records were kept of four runs of each class of locomotive, two in each direction. A short run from Elmira to Mount Morris was also made with one of the consolidations.

The consolidation locomotives were comparatively new and have been in service only a year and were in good condition of repair. Whatever advantage there was between the two classes of locomotives in this respect was, of course, however, in favor of the Mikados. To offset this, however, the engine men were not familiar with the operation of the Mikado locomotives.

Coal was measured by the number of scoops fired, the average weight of a scoopful having first been determined by actual weight. A record of the number of scoops was kept by means of counters.

On the consolidations a No. 5 scoop was used, the average weight of the scoopful being 17½ lbs.; while the Mikados were fired with a No. 3 scoop, the average weight being 14½ lbs. Two firemen were used on the consolidations, which is the regular practice, while one fireman handled the Mikados.


CYLINDER CENTERING DEVICE.

The weight of water per inch of depth in the tanks was accurately determined and the water level measured through the manhole.

No attempt was made to surround the tests with special conditions. On every run, both the locomotives and the crew operating them were those assigned in the regular course. A good quality of coal and of the same grade was used on all the runs.

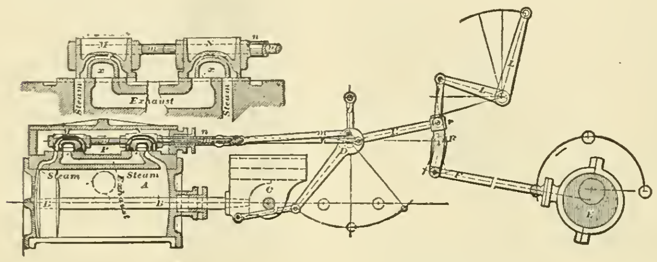
As a result of the introduction of the new engines, helper service on the Groveland grade has been reduced, and three

of the helpers formerly used have been released for road service.

The Mikados are equipped with superheaters having 1,085 sq. ft. of heating surface as well as brick arches. The consolidations have neither superheaters nor brick arches, and as far as details and general design are concerned, represent the common conventional practice for locomotives of their type.

We think that had the consolidation engines been equipped with brick arch and superheater they would have done the work as economically as the Mikados.

Philadelphia, Pa. A. Macleay.



STEVENS LOCOMOTIVE VALVE GEAR.

Stevens Valve Gear.

Editor:

Replying to an enquiry relative to the Stevens Valve Gear, would state that we have at the present time, in operation on the Southern Pacific, 25 locomotives equipped with the gearing. These engines were built twenty-five or more years ago, and belong to our older class of equipment that are used only on light service on account of their limited size.

The Stevens Valve Gear is a modification of the Walschaerts gear and the principles of the Walschaerts gear were considered in designing it, the only organic difference being in the application of independent valves, the stems of which worked one within the other, connecting each with pins on the combining lever, the result of the combination consisting in a differential motion of front and back valves. We have never been able to determine any positive merit in the arrangement to offset the objection to duplication of parts and cost of maintenance of such an arrangement.

The engines to which the Stevens gear was applied had boilers of insufficient capacity to enable the engines to render satisfactory service, and the valve motion required considerable more expense for maintenance, owing to the duplication of parts referred to. We have no figures on hand as to extra cost of maintenance as compared with single valves, but from observation and experience with this class of engine we are safe in stating that the maintenance exceeded at least 10 per cent. that of engines equipped with Stephenson link and single valves. H. J. Small,

Gen. Supt. Motive Power.

Southern Pacific Company,
San Francisco, Cal.

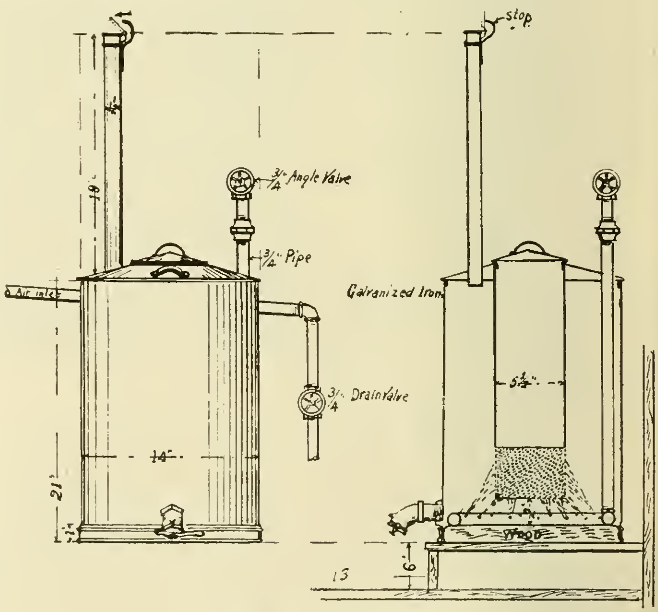
Paint Mixer.

Editor:

Attached print shows an air paint mixer which thoroughly mixes the paint by simply opening the air valve which admits the compressed air at the bottom of the mixer, which has a large number of holes, as shown, 3/32 of an inch in diameter, and 2 ins. apart. A number of these mixers are placed on a bench to hold paints of various colors, and before finishing the day's work the workmen pour back into the mixers the quantity of paint that may be left over in their pails, and on resuming work next day they simply open the air valve, which rapidly and thoroughly mixes the paint, which may be drawn off at the bottom of the mixers. At the top will be noted an air release opening which relieves the pressure so that there will not be too great a pressure in the mixer can. This valve closes automatically when the pressure of air is shut off. A coiled pipe with holes, as shown, is placed in the bottom of the mixer. The pipe may be screwed in a tee joint at one end and soldered at the other. The holes in the coiled pipe may be advantageously placed 2 ins. apart, and 3/32 of an in. in diameter, as in the mixer. The details of the manner of connecting the air pipe will readily suggest themselves to an intelligent pipefitter. Charles Markel,

Shop Foreman, C. & N. W. Ry.

Clinton, Ia.



PAINT MIXING APPARATUS.

Another Freak.

The advertisement of certain chocolates that appears in certain papers has a locomotive supposed to be hauling a train of the sweets. It must be working vigorously, for the main rod of the engine is connected with the hind wheel of the leading truck.

In grinding copper on a carborundum wheel, the copper always clogs. By rubbing on tallow this is avoided, and it does not impede the cutting of the wheel.

Painters should not wash their hands in turpentine. Use horse hair with a little kerosene, and then finish with soap and water.

Old Time Railroad Reminiscences.

BY S. J. KIDDER.

As noted in the previous article, the progress exhibited in the development of the railways of New England was without a parallel, considering the comparative newness of the country and the amount of wealth it embraced.

The Western Railroad, now Boston & Albany, extending from Worcester to Albany, 156 miles, had the largest mileage under one management.

Trains were usually designated on the time card as 1st Train, 2d Train, etc., in both directions, with an occasional Express or Steamboat train, and in some instances the name of the conductors was given together with the particular trains to which they were assigned. The expressive titles, general manager and general superintendent had not yet been born, the highest operating official usually being known as superintendent, agent, or chief engineer.

The fastest schedule trains were: Boston & Providence, distance 43 miles, one intermediate stop, 34.8 miles per hour. Fitchburg Railroad, 50 miles, two stops, 31.6 miles per hour. Boston & Maine, 26 miles, no stops, 34.66 miles per hour, while the fastest train on the New York & New Haven, 76 miles, four stops, made 25.33 miles per hour.

On double track railroads the average running time of accommodation trains, making all stops, was nearly 24 miles an hour, while those on single track were a good second, about 22 miles an hour.

In 1850 there were some 76 railroads in New England which, with very few exceptions, were under separate management.

The rates of fare on these railroads varied from something less than two cents per mile to a fraction more than three cents, with a grand average of 2¾ cents, not a bad comparison to present rates, and in a number of instances where two or more railroads made a through line arrangement the rate of fare was somewhat lower. Tickets purchased at the ticket office were "five cents less in each instance and tickets will be sold at all stations where there are station agents."

Commutation tickets if taken for a year were sold by some of the Boston railroads at a discount of from 10 to 20 per cent. from regular rates, or 10 per cent. discount for six months. The tickets were of very thick, heavy cardboard, perhaps 2 ins. x 4 ins. in dimension. No punches were then in vogue and the tickets were used over and over again until worn out. Half-fare tickets for children, 4 to 12 years of age, were designated by having one of the corners removed. "Season tickets are not to be used on Express business," presumably meaning through trains, "and entitle the bearers to carry nothing but strictly personal baggage, or such parcels as may be taken in the hand, without incommoding other passengers."

"Other articles or merchandise, are not to be taken as baggage, except at the discretion of the conductor, and by paying extra."

The railroad connections were as a rule with stage coaches rather than other railroads, for while a railroad 50 miles in length might have a dozen, more or less, connections with stages the connection with other railroads were decidedly few.

Quite a number of railroads had steamboat connections, the following being a sample announcement: "The 3d Train," Boston & Providence Railroad, "is the Steamboat train which carries passengers to Stonington, where they take a steamboat to New York." "Cabin passage to New York $4, Deck do. do. $2.50." "Baggage to and from New York is checked and accompanied by a Baggage Master especially employed for that purpose." "Baggage—The company contracts to carry 80 pounds of personal baggage, not valued over $200. It will carry baggage of greater value than this sum by special contract, and the payment of an extra charge, and not otherwise." "See printed notice on the passage ticket." The "Index to Steamers" covered routes between Boston and Portland, and from New York to Halifax and Liverpool, New Haven, Norwich, Stonington and Fall River.

That the express business at this early day had assumed a considerable measure of importance is evidenced by the following:

"It is not inappropriate to add, that commensurate with the progress of railway communication, has been the increase of the facilities for the transaction of business between all parts of the country, afforded by Expresses." "The earliest Package Express of which we have any knowledge, was established between Boston and Lowell on the opening of the B. & L. R. R. in 1835, by Mr. W. C. Gray, of Lowell." "The number of expresses now (1850), regularly running from Boston is 207." "Upwards of 800 cities and towns in New England are accommodated by them, while their arrangements extend to the principal cities of the Union, and to foreign countries."

Among the "Rules and Regulations" adopted by the railroads in regard to passengers were the following:

"Passengers must procure tickets before taking their seats in the cars.

"They must not smoke in the cars or station houses.

"They are not allowed under any circumstances to stand on the platforms of the cars.

"They must not take or leave the cars while in motion, nor put their heads or arms out of the car windows.

"Railway superintendents respectfully beg leave to remind gentlemen who SPIT, that the car floors cannot be washed while the train is in motion."

It is not generally known that the old time railroads had a standard of time as the minutes of a superintendent's meeting indicate. "At a regular meeting of the New England Association of Railroad Superintendents held in Boston, October 24, 1849, it was deemed expedient to take as the standard of time a meridian about 30 miles west of Boston. It was therefore voted, that the Association recommend to all railroad companies in New England, the adoption (for this standard) of a time two minutes after the true time at Boston as given by Wm. Bond & Son, and that on and after the 5th of November, 1849, all station clocks, conductors' watches, and all time tables and trains should be regulated accordingly."

Railroad Development in Mexico.

Extension of the Mexico Northwestern Railway from Chihuahua to El Paso has progressed steadily during the past year in spite of disturbances which kept the road between Madera and Chihuahua practically closed to traffic for some months. The northern extension has been completed, with the exception of tunnels in the neighborhood of Pearson. This road traverses the best agricultural section of the State, and its opening will give a new impetus to the several extensive ranching and farming enterprises in the Guerrero Valley near Madera. The main purpose of the road at present is to furnish transportation for the large lumber production of the Madera and Pearson mills. The latter is now nearing completion, while the former was put into active operation in 1909. The Kansas City & Orient Railroad made little progress during the past year, but has kept its two branches in operation. This road promises to be one of the most important for northern Mexico yet undertaken, giving this section, as it will, a Pacific outlet for the products of the State and at the same time almost an air-line connection with the center of the Mississippi Valley region of the United States.

Railway Traffic in Palestine.

The narrow-gauge railway from Jerusalem to Jaffa carried 10.750 first-class and 158,450 second-class passengers in 1911, as compared with 12.238 first and 155.262 second-class in 1910. Of the first-class passengers in 1911, 6.700 were tourists, while 32.700 of the second-class were pilgrims. A total of 46.500 tons of freight was handled by the road in 1911, against 42.200 tons in 1910. Most of this freight is shipped from Jerusalem to Jaffa

---

If a little chalk is rubbed on a file before filing steel, it will keep the chips from sticking in the cuts on the file and scratching the work.

Pacific Type of Locomotives for the Western Maryland Railroad

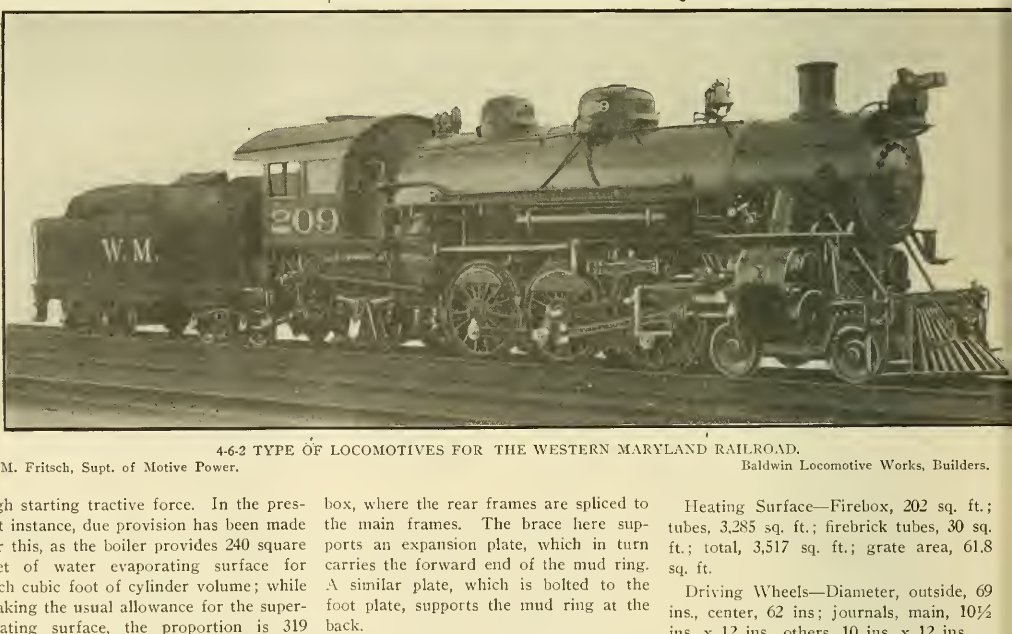
Among recent orders filled by the Baldwin Locomotive Works are nine Pacific type locomotives for heavy passenger service on the Western Maryland Railroad. These engines are designed to traverse 22 degree curves, and are built with heavy spring rigging and structural parts, so that they are suitable for severe mountain service. The tractive force exerted is 36,700 pounds—an increase of nearly 12 per cent. compared with previous locomotives of the same type built for this road. With 150,000 pounds on driving wheels, the ratio of adhesion is 4.1. The tractive force even under favorable rail conditions is thus close to the maximum that can be obtained with this adhesion weight.

In heavy duty, such as these locomotives will be called upon to perform, boiler capacity is quite an essential as high starting tractive force. In the present instance, due provision has been made for this, as the boiler provides 240 square feet of water evaporating surface for each cubic foot of cylinder volume; while making the usual allowance for the superheating surface, the proportion is 319 square feet. The ratio of grate area to water evaporating surface is as 1 to 57. The furnace contains a security sectional arch, which is supported on four water tubes.

The superheater is of the Schmidt top header type, with 32 elements; and the superheating surface amounts to 760 sq. ft. The superheated steam is conveyed to the steam chests through outside steam pipes, and the distribution is controlled by 14-in. piston valves. These are driven by the Baker gear, and are set with a lead of ¼ in. The cylinders are provided with vacuum relief valves, and with by-pass valves of the Sheedy type. A six-feed lubricator is used, with one lead to each steam chest, one to each cylinder barrel and one to each of the two air pumps.

The frames are 5-ins. wide, and each main frame is cast in one piece with a single front rail. Steel deck plates brace the frames transversely at the front and back of the cylinders, and these deck plates are bolted to the cylinder castings. The upper frame rails are braced transversely by the guide yoke, valve motion bearer and waist sheet cross-tie, which are all of cast steel. These castings have long bearings on the frame, and are lipped on both sides. The front pedestals at the first pair of drivers, and the back pedestals at the rear pair, are braced by deep steel castings. Further bracing is provided under the front end of the firebox, where the rear frames are spliced to the main frames. The brace here supports an expansion plate, which in turn carries the forward end of the mud ring. A similar plate, which is bolted to the foot plate, supports the mud ring at the back.

These locomotives, although they embody no new or untried features, are of interest because of the high capacity secured in an engine of limited weight, and because of their special suitability for heavy service on a line having steep grades and sharp curves. The lighter Pacific type locomotives previously used on this road have proved a decided success; and the new engines, on a comparative basis, may be expected to show a considerable increase in capacity, together with a marked reduction in fuel and water consumed per horsepower developed.



4-6-2 TYPE OF LOCOMOTIVES FOR THE WESTERN MARYLAND RAILROAD.

C. M. Fritsch, Supt. of Motive Power. Baldwin Locomotive Works, Builders.

The following are the principal dimensions of this type of locomotive:

Gauge, 4 ft. 8½ ins.; cylinders, 24 by 28 ins.; valves, balanced piston.

Boiler—Type, wagon top; material, steel; diameter, 74 ins.; thickness of sheets, ¾ and 13/16 in.; working pressure, 185 lbs.; fuel, soft coal; staying, radial.

Fire Box.—Material, steel; length, 111 ins.; width, 80¼ ins.; depth, front, 78¾ ins.; depth, back, 65¼ ins.; thickness of sheets, sides, ⅜ in.; thickness of sheets, back, ⅜ in.; thickness of sheets, crown, ⅜ in.; thickness of sheets, tube, ½ in.

Water Space.—Front, 4½ ins.; sides, 4 ins.; back, 4 ins.

Tubes—Diameter, 5½ ins. and 2¼ ins.; material, steel; thickness, 5½ ins,, No. 9 W. G., 2¼ ins., No. 11 W. G.; number, 5½ ins., 32; 2¼ ins., 202; length, 20 ft.

Heating Surface—Firebox, 202 sq. ft.; tubes, 3,285 sq. ft.; firebrick tubes, 30 sq. ft.; total, 3,517 sq. ft.; grate area, 61.8 sq. ft.

Driving Wheels—Diameter, outside, 69 ins., center, 62 ins; journals, main, 10½ ins. x 12 ins., others, 10 ins. x 12 ins.

Engine Truck Wheels—Diameter, front, 33 ins.; journals, 6 ins. x 10 ins.; diameter, back, 42 ins.; journals, 8 ins. x 14 ins.

Wheel Base—Driving, 12 ft. 6 ins.; rigid, 12 ft. 6 ins.; total engine, 33 ft.; total engine and tender, 67 ft. 3¾ ins.

Weight, Estimated—On driving wheels, 150,000 lbs.; on truck, front, 42,000 lbs., back, 45,000 lbs.; total engine, 237,000 lbs.; total engine and tender, 385,000 lbs.

Tender—Wheels, number, 8, diameter, 33 ins.; journals, 5½ ins. x 10 ins.; tank capacity, 8,000 gals.; fuel, 12 tons; service, passenger.

Crazed by Trying Invention.

At several times during industrial history the rewards for the devising of inventions have been so munificent that many persons have turned to the occupation of inventor as a means of securing a livelihood. The business of inventing is different from other occupations, for comparatively few persons possess the inventive faculty, just the same as having an ear for music is not the natural inheritance of every child. A man deficient in natural turn for inventing things, is just as likely to fail when he takes up the business of inventing, as a person who has no ear for music will fail when he undertakes to produce musical compositions. Sometimes people become inventors from choice; others become inventors through accident or force of circumstances. Our chief relates particulars of how a working machinist became an inventor by striving to find out why an injector failed to work. The story goes:

One day we encountered a crowd of men looking at a particular engine and watching efforts of Jim Davis, a machinist, striving to keep an injector operating. The instrument would start the overflow quite strongly, but when the overflow valve was closed the injector would break. Davis was acting as mentor and leading wise man, but it seemed that the combined wisdom, knowledge, and experience of the establishment was consulted and invited to diagnose the cause of failure. As we joined the conference Davis proceeded to give a talk on the principles of an injector's action in which he displayed profound ignorance of induced currents and of the inertia of matter in motion.

The foreman looked on while several attempts were made in vain to get the injector working, and Davis protested that the injector was not made right and that it never would be made to do its work properly. He had repaired hundreds of injectors and knew what he was talking about. However, his extensive knowledge failed to make that particular injector work, so the foreman told him to try another injector. This was done and the injector taken from the store house acted in precisely the same way that the other had done. Further investigation revealed the fact that the trouble was in the delivery pipe, which had a loose sliver inside that obstructed the flow of water and reduced the velocity of the water necessary to overcome the resistance at the check valve.

The case was simple enough, but Davis had had his attention directed to difficulties with injectors, and he declared that he could invent and make an injector that would be superior to anything upon the market. From that day the man suffered from injector on the brain, and neglected his ordinary work to sit cogitating about his projected invention and later on to work upon it by stealth. His hallucination was endured in the hopes that it would soon pass away, but it turned out to be truly persistent.

The injector was duly finished and tried but it failed to throw water. It was altered and tinkered with for weeks and finally consented to inject a feeble stream of water into a boiler. Its success was a triumph and turned Davis's head. He had become an inventor, and all he needed was a patent upon his injector to make his fortune. It was no easy matter raising the money to pay for patent papers, but the members of the church Davis belonged to contributed mites, and application for the patent was made. The modern up-to-date patent lawyer, who will secure a patent on any invention by making it a combination of valuable features, had not developed at that time and the patent was refused on the ground of lack of novelty.

Davis stamped and protested as vigorously as a church member could, proclaiming that a poor man could not receive justice from the patent office scoundrels, and became a man with a grievance. From being a fairly pleasant man to have intercourse with, he became a one idea misanthrope with a snarling, discontented manner. He could not differ from a fellow workman without insulting him. Instead of attending to his work he was cnstantly looking for some victim to listen to his tale of woe. Remonstrance was useless. He was steadily demoralizing the shop force, and it was considered necessary to discharge the inventor. On his way home Davis had to cross a bridge spanning a deep gully with a rapid river at the bottom. He jumped off that bridge and ended a career ruined by the allurement of becoming an inventor.

Labor Saving.

It was thought when labor-saving devices flooded the market that men would lose their occupations in consequence, that there would be nothing for them to do. The very opposite has been the case. Take, for instance, an invention which has affected, or rather, revolutionized, one branch of woman's industry—the invention of the sewing machine. Long ago gowns were made as plainly as they could be made. The skirts were plain and wide, lined or unlined, and gathered into a waist-band. The seams were run up by hand in no time in the day of swift hand-sewing, and the bodice might be pointed or straight, but there was comparatively little work upon it, and its fit was more a matter of chance than good guidance. A woman could make such a dress in a day without distressing herself greatly. When sewing machines came upon the market the dressmaker thought she saw her occupation gone. But how different has been the case. Gowns are not tossed off in a day at this present date. The fit and finish must be perfect, and the amount of sewing on a betucked or a befrilled dress of recent times would have made the hair of an old-fashioned dressmaker stand on end. Never were so many hands employed in dressmaking as now, and never was dress so elaborate and so costly. The dressmakers' fees have proved an illusion. It was thought, too, when railway traveling took the place of the old stage-coaches, that a perfect army of men would be thrown out of work—roadmen, drivers, etc., and instead of that the railway absorbs a thousand times the work of the older system of travel and conveyance. It has been so in every department of life. Instead of labor-saving inventions meaning less labor they have meant infinitely more. Never were workmen in many branches of trade so scarce, and never was women's work in greater demand that it is now. We ask better work and finer, and more of it, and as the day is not a minute longer we are more hurried in spite of all the labor-saving inventions under the sun.

The Latest Railway Scheme.

Some immense railway combinations have been carried on in the last two decades, but others of no less magnitude have failed, and may yet be carried to a successful consummation. Edwin Hawley, who controlled the so called Moffet roads, had a scheme to establish a system of railways from Canada to the Gulf by way of Colorado, traversing the country diagonally. The scheme came to an end through Mr. Hawley's death.

It is said that a similar combination is in course of being worked out by two financiers, Dr. F. S. Pearson and Percival Farquhar, a pair of Scottish-Americans of far-seeing vision, in control of immense capital. This projected enterprise is to take the Canadian Northern, a most ambitious project, which is intended to extend from Nova Scotia to the North Pole by way of Montreal, Winnipeg and Vancouver, as the northern basis of lines that will absorb the Denver Northwestern & Pacific, the Missouri, Kansas & Texas, the Minneapolis & St. Louis, and the Iowa Central extending with brief intermissions from Hudson Bay to Galveston.

These enterprising capitalists have ventured but once before into the realms of American railroads. That was an intrepid venture, conceived after the imagination of Harriman, but not at all executed in the Harriman fashion. It contemplated nothing less than the consolidation of the Western Gould lines, the Rock Island, Wabash and Lehigh Valley into a transcontinental threatening to disturb all the old relations among all the old big systems of the Northwest and West.

To Prevent Car Shortage.

In ordinary times railway freight cars are largely used for the storage of the goods they have carried, but when there is no scarcity of cars the owners are very forbearing about claiming damages for delays in unloading. Matters are on a different footing today, nearly all the railroad companies are making strenuous efforts to have cars unloaded promptly and many of them have special agents out watching to prevent delays in getting cars emptied and returned to new service. The Pennsylvania Railroad is taking a lead in keeping freight cars moving.

One of the precautions which that company is taking against car shortage is to prevent, as much as possible, the holding of loaded cars at seaports. The moment notice is received of an accumulation of cars loaded with freight for export, steps are taken to have the cars released at the earliest possible time. In cases where loaded cars accumulate because of free storage time in warehouses new rules are made to keep traffic moving through the warehouses, thereby permitting the prompt unloading of cars. In addition to requesting shippers to load and unload cars promptly and to load them to capacity the railroad has announced that unusual efforts are being made to reduce the amount of equipment awaiting repairs and to complete unfinished work on new cars and locomotives.

A Case of Infinite Grit.

Several months ago we mentioned that a prominent western railroad company, having instituted an inspection of all the trainmen for the detection of color-blindness, it was found that one of the oldest passenger engineers could not read or write. The result of this discovery was that the man was taken off the road at once, and notified that he could have a switch engine to run. Instead of accepting this oblique promotion, he asked and received leave of absence for three months. Then he went home, got the assistance of a teacher, and began laboring to acquire a knowledge of reading and writing. This was done so vigorously that at the expiration of his leave he wrote a very respectably penned letter to the master mechanic intimating that he was ready to take his engine.

To Increase Efficiency.

Efforts to increase the efficiency of workers are still going on although the tongues of the Brandeis type of reformer are not so turbulent as they once were. One of the latest schemes for increasing the output of a factory is worthy of the high apostle of scientific management. A shoe manufacturer made up his mind that the productivity of the girls in his establishment suffered from the tendency of the young lasses to talk during working hours, so he placed within their reach gum vending slot machines, with the idea that should their jaws be occupied chewing gum there would be less tendency to waste energy in profitless gossip.

The Valve World takes this case as worthy of scientific investigation, and raises the salient question, does the wagging of the tongue in talking consume more muscular and nervous energy than vibration of the jaws in chewing? If the boot makers of the United States succeed in settling this difficult scientific question, they may succeed in increasing mechanical efficiency to the extent of producing two welts where only one and nine-tenths of a welt was produced before.

TEN-WHEELERS FOR THE LONDON & NORTHWESTERN RAILWAY.

Ten Wheelers in Great Britain.

The British locomotive builders seem to be unable to get beyond the ten-wheelers, and for certain kinds of traffic, particularly what may be called suburban passenger traffic, they are a very serviceable type of locomotive. The accompanying illustration shows one of the latest of that type, named "The Prince of Wales." It was built recently at the extensive shops of the London & North Western Railway at Crewe. It is similar to the earlier 4-6-0 type of locomotives used on the same road and known as the "Experiment" class. The cylinders are larger, being 20½ ins. by 26 ins. The driving wheels are 6 ft. 3 ins. in diameter. It is fitted with the Schmidt superheater. As is usual with nearly all of the British type of locomotives, almost all of the motion work is inside of the frames, and to the eyes of even a skilled mechanic it is a wonder how the work can be got at. The most admirable feature about the locomotives are the frames, which are of the plate type, being made of strong boiler plate substantially riveted together, and almost entirely free from breakage. As will be noted, the cab does not afford a very extensive protection, but it must be remembered that the climatic conditions are not so severe in England as in many parts of North America.

Coal Briquets in Belgium.

The industry of coal briquet making has been making great progress in Belgium during the last few years. Briquets are used almost entirely as fuel by the railroads of the country, and they are also generally used in the factories, especially those for manufacturing glass. Owing to the great demand the price was raised 50 centimes (10 cents) per ton July 1, 1911, for the briquets for private customers and 1 franc (19.3 cents) per ton for the navigation companies and the Belgian railroads.

Advertising in Foreign Countries.

A new and original method of advertising has been adopted by American manufacturers seeking business in remote countries, where it would be inconvenient and expensive to convey the actual machines. They have moving pictures made of their machinery at work and exhibit them free to the natives. That form of advertising has made a decided sensation, and they say that several machine tool makers are about to adopt the idea, and some are of the opinion that it would be a good scheme to have exhibits of a similar kind in the more remote parts of our own country.

Fair Treatment for the Railways.

The practice of abusing railway companies and shouting for the indiscriminate reduction of rates is not so prevalent as it was a few years ago, but there is more of the antagonistic sentiment still manifested then there ought to be. Sensible and fair-minded newspapers are doing much to turn the tide of opprobrium away from railway interests and it is to be hoped that the good work will be continued. The New York *Sun* has been conspicious in its defense of railways and a recent issue says:

"Measured by the standard of the prices of commodities in general, and it is what things cost that determine the value of money, railway rates have actually decreased something like 25 per cent. in the last decade.

"The prices of commodities in general rise and fall with the fluctuations in supply and demand, but the price of transportation, the only thing the railways sell, is held hard and fast under governmental regulation. In most employments the rates of wages rise and fall with fluctuations in supply and demand, but the wages of railway employees have been rising steadily, and it has been impossible for the railways to reduce them even in times of stress.

"Capital is the only thing needed by the railways which refuses to be bound by artificial fetters. It persists in going where it can obtain the best security and the most satisfactory returns. Prior to 1880 capital was expended in railway construction in greater proportion than it went into either agriculture or manufacture. Since 1900 the capital value of agriculture and manufacture has increased at three fold the rate of the increase in railway capital. In 1900 the capital value of the railways was about 15 per cent. greater than that of manufactures and about half that of agriculture. In 1910 the capital value of the railways was over 20 per cent. less than that of manufacturing and only one-third that of agriculture.

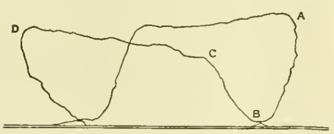
"The only way the railway can obtain capital is to offer the assurance of return that will attract it. In order to offer such assurance they must be permitted to increase their rates or decrease their expenses. The country needs more railways and it needs better railways. Those who know say that the amount of capital neccessary to place the transportation facilities, especially of the western part of the country, abreast of the agricultural and manufacturing development is almost inconceivable.

"Through the accounts prescribed and published by the Interstate Commerce Commission the people of the United States can ascertain what becomes of every dollar of capital acquired by any railway company and what use is made of every dollar received by it from the sale of transportation. It is as useless at this time to make recriminations against the railways because of the sins of railway buccaneers of the past as it is to conjure up the evils that led to the civil war. It was no more necessary after the civil war that the old causes of bitterness should be forgotten and all of the people work together for the good of the whole nation than it is now necessary that old errors of commission or omission, whether on the part of the railways or on the part of the people, shall be forgotten and the whole people join for the good of the whole nation in seeing that the railways have fair treatment.

"The country needs more railways and better railways. If it does not obtain them the cultivation of the field will relax, the operation of the mines and mills will halt, our markets dwindle. It is a condition and not a theory that confronts us."

Reversed Motion Diagram.

The annexed figure is a reproduction of an indicator diagram taken from a locomotive running a passenger train on the Chicago, Alton & St. Louis Railroad when the motion was reversed. As it may puzzle some of our readers to interpret



INDICATOR DIAGRAM WITH VALVE MOTION REVERSED.

the lines, we will venture an explanation. The piston begins to move from the center at A and meets with litle resistance till the point B is reached, where the valve closes. The back resistance, due to the compression of air within the cylinder, then increases rapidly till point C is reached. The cylinder-cock being open, enables part of the compressed air to escape, and the pressure does not rise to boiler tension. When the point D is reached the valve opens, and the pressure quickly falls to near the atmospheric line. The card taken from the other end of the cylinder does not differ materially from that described.

Smoke as Aid to Invention.

When George Richardson, inventor of the Pop Safety Valve, of the Richardson Balanced Valves and other inventions was pursuing his mechanical experiments, he was in the habit of using smoke puffed from a cigar to indicate certain air currents. History is said to repeat itself and the same may be said to happen with the working out of inventions. W. Rowland King, a British inventor gave the following information to a London paper:

"For years past," he said, "I have been experimenting with smoke, with the object of learning how air currents behave, so as to gain data for the betterment of monoplanes. I used to get smoke and drive it against an object, and watch how it behaved. From what I have learned I have now designed a machine which will fly efficiently and practically silently." The monoplane had been built at Hendon. In shape it is totally unlike every machine at the aerodrome, and, if it fulfills the maker's anticipations, will go a long way toward solving a number of problems which have been perplexing the builders of air craft.

Coal and Grain.

Among people of an inquiring turn of mind the question is frequently raised what will the world do when the supply of coal is exhausted; for at the rate coal is being used and wasted its exhaustion is only a matter of a few centuries. Those who have given the subject the most earnest study, do not take a gloomy view of the mechanical future of the earth.

It must not be forgotten, says Professor Reynolds, that the most important source of energy is not coal but grain and other vegetable matter. The power developed in the labor of animals exceeds the power derived from all other sources, including coal in the ratio of probably 20 or 30 to 1; so that after all, if we could find the means of employing such power for the purposes for which coal is specially employed—such as hauling our railway trains and propelling our ships—an increase of 10 per cent. in the agricultural yield of the earth would supply the place of all the coal burned for our steam engines.

Heat and Temperature.

There is a positive difference between heat and temperature which many engineers fail to recognize. In raising water to the boiling point a certain volume of heat is expended which may be identified by the thermometer, but after the boiling point, 212° Fah. is reached 966.6 heat units must be put into the water to convert it into steam and the temperature of the steam will remain the same as that of the water when boiling began. That 966.6 is known as the latent heat of steam and is the heat expended in tearing the atoms of heat asunder in the process of steam generation.

A practice is finding its way into favor of leaving a portion of station water tanks beneath the spout pipe as a reservoir in which sediment in the water supply may settle and get drawn out without passing into the locomotive tank. That practice ought to be universal and would be generally adopted if the water supply stations were under the supervision of the motive power officials.

Catechism of Railroad Operation

Questions and Answers.

Second Series.

The Mallet Articulated Locomotive.

By F. P. Roesch.

Errata.

Referring to the answer to the fourth question in the Catechism of Railroad Operations published last month, page 371, the concluding sentence is in error, the starting valve, in the Baldwin type of Mallet locomotive, being connected as stated in answer to the third question, page 370, the appliance being simply a valve operated from the cab, connected to a pipe which admits steam direct to the receiver, from whence it passes to the low pressure cylinders, this starting valve pipe being so proportioned with reference to the receiver pipe that the pressure of the steam from the boiler admitted to the receiver through the starting valve is reduced to the desired amount.

(*Continued from page* 371.)

Q. What other reasons are there for making the rear, or rigidly connected engine, the high pressure engine?

A. As the steam in its final exhaust must pass through the stack in order to create a draft on the fire, if the rear engine were the low pressure engine, it would require an extra length of exhaust pipe, thereby increasing the back pressure in the cylinders. It would also involve quite a complication of steam pipes, in that both the live steam and the exhaust pipes, together with the receiver pipes, would necessarily have to be of a flexible construction.

Q. How are both engines secured to the boiler?

A. The rear, or high pressure engine, is rigidly attached by means of a cylinder saddle; the frames being attached by means of expansion pads or expansion links. The forward, or low pressure engine, is not attached to the boiler at all, the boiler simply resting on heavy bearings so as to allow the boiler to swing laterally over the forward engine when the locomotive is passing through a curve.

Q. As the forward engine is not attached to the boiler, what holds this engine in place when pulling or working steam?

A. The forward engine is held in position by having the rear end of the frames connected to the front end of the high pressure engine by means of a flexible connection similar to a draw bar.

Q. How is the power of the forward or low pressure engine exerted to the draw bar at the rear of the tank?

A. Through the frames of the rear engine, to which the forward engine is flexibly connected.

Q. Would it be safe to try to handle a train if the pin connecting the forward to the rear engine became lost or broken?

A. No; as in this case the forward engine might be pulled out from under the boiler.

Q. What would you do in case the pin or connection connecting the forward with the rear engine became broken?

A. If the pin simply dropped out, would get it and replace it. If the pin or any other part of the connection was broken, would chain the rear engine to the forward engine with heavy chains. In case no heavy chains were available, would use any kind of a chain that I could get of sufficient strength to hold the low pressure engine in place, set out train and come in light.

Q. Why is the forward or low pressure engine, not rigidly attached to the boiler, the same as the rear or high pressure engine?

A. Because in this case it would make both engines rigid, thereby increasing the rigid wheel base of the locomotive to such an extent that the locomotive could not negotiate anything but the longest curves, and would be apt to be derailed in entering turnouts such as passing tracks, etc.

Q. Trace the steam from the boiler to the atmosphere.

A. When the throttle is opened, steam passes through the standpipe into the steam-pipes to both high pressure steam chests; thence, by the movement of the valves, it is admitted alternately to the ends of the cylinders and exhausted from the opposite ends, through the valves to the exhaust channel in the cylinder saddle; thence to the receiver pipe; from whence it is conveyed to the low pressure steam chests; where, by the movement of the valves, it is admitted to and exhausted from the low pressure cylinders, the final exhaust passing through the exhaust pipe and out through the stack to the atmosphere.

Q. What would you do in case of an accident to the main exhaust pipe?

A. If the exhaust pipe was broken off so that all the exhaust steam would escape through the break before it passed to the exhaust nozzle, would block up the end of the exhaust pipe leading to the nozzle and depend upon the blower to furnish sufficient draft to make steam enough to handle the locomotive. If the main exhaust pipe simply leaked bad, would go on with the train, using the blower to aid in creating a draft, if necessary.

Q. What would you do if the exhaust pipe from the high to the low pressure cylinders broke?

A. As this is the receiver pipe conveying steam to the low pressure cylinders, it is evident that the low pressure engines would be cut out and useless, so far as furnishing power is concerned; and as the draft on the fire is created by the exhaust from the low pressure cylinders, it is evident that if the low pressure cylinders receive no steam, there would likewise be no exhaust to create a draft. It would, therefore, be necessary to reduce the train to what could be handled by the high pressure engine, and depend upon the blower for creating sufficient draft to make steam.

Q. In a case of this kind, would you disconnect anything on the forward or low pressure engine?

A. No, it would not be necessary.

Q. In a case where either the low pressure exhaust, or receiver pipe broke, what would you do to prevent the escaping steam from obscuring your vision?

A. Nothing could be done. It would simply be necessary to shut off frequently in passing through stations, in order to see that the line was clear.

Q. Would it not be safer, then, in a case of this kind, to set out the entire train and allow engine to be towed in?

A. Yes; but engineers, as a rule, do not like to be towed in as long as their locomotive is not absolutely helpless.

Q. What would you do in case the starting valve pipe on a Baldwin Mallet compound broke?

A. Apply a blind gasket in the union where pipe connects to steam ports.

Q. What would you do in case the reach rod to the forward engine broke?

A. Remove or tie up the broken parts to a point where they would not interfere, block the link blocks in the links at a point that you are satisfied engine would handle train—preferably about half stroke—and proceed.

Q. What would you do in case the reach rod to the rear engine broke?

A. As this reach rod is connected to the reverse lever, and since the forward reach rod is connected to the rear reach rod, in case the rear reach rod broke, it would be necessary to raise the blocks in the links of both the forward and rear engines to a point where the train could

be handled. This could be done either by means of blocking or chains.

Q. How are Mallet compounds reversed? Why?

A. Usually by means of a power reversing gear, as with this type of engine it is necessary to move about four valves, together with their tumbling shafts and their mechanism—something that would be very hard to do by hand.

Q. What type of reversing gear is commonly used?

A. A power reversing gear, operated by compressed air; or, in case of emergency, steam. This consists of a small auxiliary reverse lever, pivoted to the main reverse lever and moving with it. The movement of the auxiliary lever, operating an air valve, admitting air to one end of the cylinder of the reversing gear, moving the main lever in the same direction that the auxiliary lever is moved until the desired cut-off has been reached, when the latching of the auxiliary lever automatically latches the main lever also, and, at the same time, closes the air valve, preventing any further movement of the piston in the cylinder.

Q. With this type of reversing gear, what provision is made to prevent a rapid movement of the lever?

A. A cylinder filled with oil and containing a piston attached to the piston in the air cylinder is fastened to and worked in harmony with the air cylinder. The movement of the auxiliary lever which opens the air valve, likewise opens the valve in the oil cylinder, establishing communication between the two ends of this cylinder. This valve, having small ports, will only allow the piston in the oil cylinder to move as fast as the oil can move through the ports, thereby preventing sudden movement or "slamming" of the reverse lever.

Q. Is there any other type of reversing gear used?

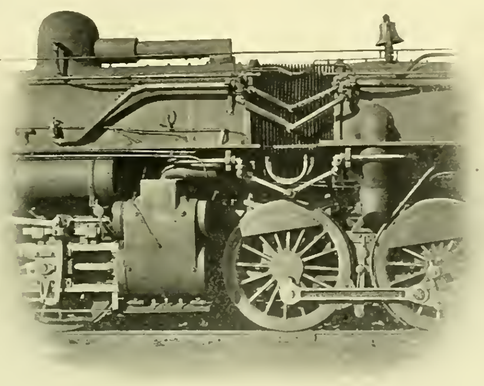
A. Yes. On some of the late designs of locomotives, a screw reversing gear is used instead of the air-operated, power reversing gear.

Q. How would you test for a blow in the low pressure valve?

A. The same as on any ordinary locomotive, by placing the engine on either quarter on the side to be tested, with the reverse lever in the center of the quadrant; open starting valve on Baldwin type of engine, and main throttle on American type, and cylinder cocks. If steam escapes from either cylinder cock, the low pressure valve being tested is blowing.

Q. How would you test for a high-pressure valve blow?

A. Place engine on either quarter on the side to be tested, reverse lever in the center of the quadrant, open cylinder cocks and open main throttle. Steam escaping from either cylinder cock will indicate that the valve is blowing.



FLEXIBLE BOILER CONNECTION IN THE BALDWIN MALLET ARTICULATED.

Q. How would you test for a blow in the low pressure cylinder packing?

A. Leave engine in the same position; that is, on either quarter; cylinder cocks open, driving brakes set, but place the reverse lever in full gear forward or back instead of in the center. Now, with the Baldwin type open the starting valve and wait until sufficient pressure has accumulated in the low pressure cylinders to give you a good test. With the American type, open the main throttle. If steam now escapes from both cylinder cocks at the cylinder being tested, cylinder packing is defective.

Q. How would you test for a blow in the high pressure cylinder packing?

A. Leave the engine in the same position as before, namely, on either quarter; reverse lever in either corner, driving brakes set, cylinder cocks open, open main throttle. If steam escapes from both cylinder cocks at the cylinder being tested, the cylinder packing is defective.

Q. How would you test for broken low pressure valve seat?

A. Same as for a cut valve, except in this case, after the valve has been tested with reverse lever in the center of the quadrant, the lever should be moved first to the forward end and then to the back end of the quadrant. A loud blow at the stack, with the reverse lever at either the forward or back end of the quadrant, but not in both positions, would indicate a broken valve or a broken bridge. If there was a blow at the stack, however, with the reverse lever both in the forward end of the quadrant and in the back end of the quadrant, it would probably indicate broken cylinder packing.

Q. How would you test for a broken high pressure valve or seat?

A. The same as for a broken low pressure valve or seat, except that instead of opening the starting valve, as would be necessary with the Baldwin type of engine, the main throttle should be opened; while on the American type, in addition to the main throttle, the separate exhaust valve should be opened. Now, in case the high pressure valve or valve seat is broken on the Baldwin type engine, the steam flowing by the broken valve or seat will pass into the cylinder, then out through the exhaust port of the valve, when the lever is in either corner, and so on to the receiver; from whence it passes to the low pressure steam chests. Now, if the low pressure valves and seats are all right, there would be no blow at the stack, and, consequently, the only way that you could determine that the valve is defective would be by a strong escape of steam from the low pressure cylinder cocks, or by the relief valves in the low pressure steam chests raising and seating. With the American type of locomotive, however, the steam escaping by the broken valve or valve seat, would pass out through the separate exhaust valve, and thence to the stack; and the defective valve could, therefore, be located by the sound of the steam escaping.

Q. What would be the effect on the working of the engine in case one of the low pressure valves or seats were broken?

A. There would be a continual blow at the stack when the engine was working, and the engine would lose power.

Q. What would be the effect in case one of the high pressure valves or seats were broken?

A. The steam escaping by the broken valve would pass into the receiver, thereby increasing the receiver pressure, causing the pop valves on the low pressure cylinders and steam chests to open. It would also reduce the power of the locomotive.

Q. What would be the effect of broken cylinder packing in one of the low pressure cylinders?

A. It would cause a blow when steam was being admitted to the cylinder hav-

ing the defective packing, the blow being strongest at the beginning of the stroke, and gradually decreasing towards the end of the stroke.

Q. What would be the effect of broken packing in one of the high pressure cylinders?

A. Same as a broken high pressure valve or seat, in that the steam escaping by the broken cylinder packing would increase the pressure in the receiver, thereby causing the cylinder and steam chest pop valves to unseat.

Q. Would broken high pressure cylinder packing cause a blow at the stack?

A. No; except on the American type of Mallet compound with the separate exhaust valve open.

Q. Which would affect the power of the locomotive to the greatest extent, and how?—broken high or broken low pressure cylinder packing?

A. Broken low pressure cylinder packing, as this would practically destroy all the power of the steam in the low pressure cylinder having the defective packing, thereby decreasing the power of the locomotive. Broken high pressure cylinder packing would increase the amount of power being developed in the low pressure cylinders, and would, therefore, not affect the power of the locomotive to the same extent as broken law pressure packing.

Q. What is a by-pass valve, and why is it used in connection with this type of locomotive?

A. The by-pass valve is a valve establishing communication between both ends of the cylinders when the engine is not working steam. It is used in connection with the low pressure cylinders in order to enable the engine to drift more freely, and to prevent the compression of air in the cylinder when drifting, as on account of the large diameter of these cylinders, the air compressed ahead of the piston would have quite a retarding effect.

Physics.

Natural philosophy or physics, the science which treats of the properties and laws of matter, ought to be studied by every person who can read. It teaches practical knowledge of the doings of every-day life. Philosophy implies a search for truth, and natural philosophy, as distinguished from moral philosophy, searches for truths connected with the material world. All the manifestations of heat come under the researches of natural philosophy as well as the operation of converting heat into work, besides the science of mechanics, sound, light, electricity and magnetism. The student who has obtained a good mastery of physics knows enough to help him to climb the ladder of life without faltering.

Panama Canal Lock

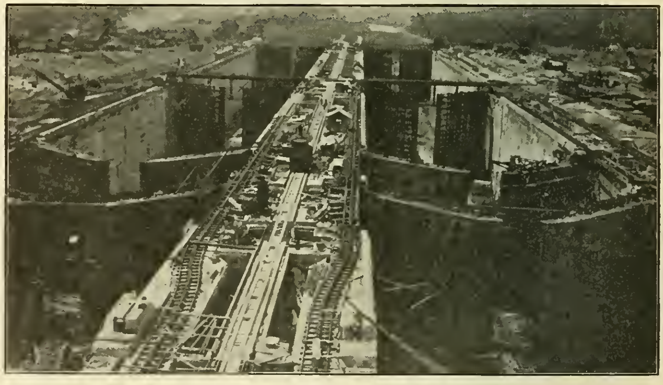
We are indebted to the New York *Sun* for the privilege of reproducing an unusually interesting photograph from Panama. Taken from the top of a crane 110 ft. high, it not only pictures the nearly completed lock at Pedro Miguel from a new point of view, but also tells the story of the giant structure as photographs are rarely capable of doing.

In the immediate foreground are the double tracks of the most expensive railroad in the world—tracks over which the heavy electric engines are to travel while they draw the various craft bound from Manzanillo Island to Perico; for no ships of whatever size will be allowed to pass through the canal under their own power. The locomotives will take their tow ropes as do the mules along the banks of the Erie Canal through New York State, and draw the ships into and through the locks.

There will be two towing tracks for or paid out without actual motion of the locomotive on the track.

The locomotives are to run over rails set in concrete on steel ties with cast steel rack gear and with conductor slots in steel. The concrete bed is on top of a wall of concrete. Concrete and steel are practically the only component parts of the construction of the mighty waterway. It will require 5,000,000 cu. yds. of concrete for the completed beds and walls. And as to the steel the pictured steel gates give as clear an idea of the use made of "concrete's twin" as any printed figures.

Each one of these gates consists of two halves or leaves. Each leaf weighs in the neighborhood of 812 tons. There are ninety-two of these leaves weighing in aggregate over 56,000 tons—more than enough steel to construct twenty miles of the finest of roads for the Pennsylvania



BIRD'S-EYE VIEW OF PEDRO MIGUEL LOCK.

each flight of locks, one on one side and one on the middle wall. On each side there will be one return track and on the middle wall a third, common to both of the twin locks. These tracks are shown for the first time in this picture.

All tracks are to run continuously the entire length of the flights and will extend out beyond the locks on the guide approach walls at each end. The number of the locomotives to be used will vary, of course, with the size of the vessel towed. The usual number required will be four; two ahead, one on each wall, towing the vessel, and two astern, one on each wall, to keep the ship in the center of the stream and to bring it to a standstill when it is well within the lock chamber. These locomotives are to be the strongest and most capable of hard work of any that have ever been constructed. They will be equipped with slip drums, towing windlasses and hawsers which will permit the towing line to be taken in

or New York Central, and more by 10 per cent. than the steel used for the big Manhattan Bridge over the East river.

Each one of these leaves is 79 ft. high, 64 ft. wide and 7 ft. thick. The picture also gives an excellent idea of the concrete sides of the lock as well as of the "middle wall." These side walls are 50 ft. wide at the base and taper up to 8 ft. at the top; the middle wall is 60 ft. wide at top and bottom. In this center wall there are three tunnels or galleries, the lowest of which is used for drainage, the second for the electric wiring for the gate and valve machinery and the top gallery for the operators.

The lock chambers are filled and emptied through lateral culverts in the floors and are connected with the main culverts formed in the side and center walls—huge affairs 18 ft. in diameter.

There are twelve locks in all, each one in duplicate. At Gatun, six miles from the Atlantic, the ships are to be lifted up

through three pairs of locks in flight, from the tide water level to that of Gatun Lake, which is 85 ft. above mean tide water; at Pedro Miguel, where this picture was taken and which is about as far inland from the Pacific as Gatun is from the Atlantic, there is one pair of locks, with a descent of a trifle over 30 ft.; and a mile nearer the coast, at Miraflores—which is seen in the distance, at the top of the picture—there are two pairs of locks with a combined descent of not quite 55 ft., through which the vessels are brought back to the sea level.

The dimensions of all the locks are the same, so that the one in the picture may be taken as a sample of the other locks in the canal.

Questions Answered

TRACTIVE POWER OF A MALLET.

212. T. A. S., Dupo, Ill., writes: What is the rule for calculating the tractive effort of a Mallet compound equipped with superheater? A. The formula for two cylinder compound locomotives is:

$$T = \frac{C^2 \times S \times 0.6\ P.}{D}$$

T=rated tractive force in pounds.

C=diameter of high-pressure cylinder in inches.

S=stroke of piston in inches.

P=boiler pressure in pounds.

D=diameter of driving wheels in inches.

In the case of the Mallet compound locomotives, the formula given above for two cylinder compound locomotives, is also applicable to Mallet type locomotives, the result being multiplied by two as the Mallet type has four cylinders. The formula thus modified is as follows:

$$T = \frac{C^2 \times S \times 1.2\ P.}{D}$$

The formula for two cylinder and Mallet compound locomotives, assume a cylinder ratio of approximately 2.35 to 2.40.

SANDING RAILS.

213. P. F., Pueblo, Col., writes: In running and slipping rails is it best to keep a small stream of sand running all the time, or only occasionally? A. It depends largely on the locomotive equipment. In the case of the ordinary sand valve, it would be impossible to deliver a fine stream of sand, and the sand would soon be wasted if allowed to flow continuously. A pneumatic sander can be made to deliver a fine stream, and such a flow may be permitted to continue as long as necessary. No exact rule need be followed, and it will be found that enough sand will stick to the rim of the wheels to make a continuous flow under any circumstances unnecessary It is well to remember that in the case of persistent slipping it is advisable to shut off steam, then open the sand valve and again admit steam to the cylinders.

DAMAGED STEAM GAUGE.

214. J. M., Stroudsburg, Pa., writes: We had some discussion in regard to what should be done in case of a damaged steam gauge, and would be pleased to have your opinion of the matter. A. Nothing need be done further than to shut of the supply of steam from the boiler to the gauge. The safety valves may be relied on as indicating the maximum pressure, and engineers of experience can tell the approximate pressure by the noise of the escaping steam from the upper gauge cock. At the same time the gauge should be repaired or another gauge, newly tested, should be applied as soon as possible.

TANK SWEATING.

215. W. L. C. Sheridan, Wyo., Ark.—What is the cause of tank sweating, and how is it that it does not always sweat, and is there any way of preventing it? A. Sweating is caused by changes of atmospheric conditions. When the temperature of the water in the tank is lower than the surrounding atmosphere it has the effect of condensing the moisture in the outer air and the condensed particles adhering to the tank appear as if the water was coming through the tank as in sweating. The only prevention is by raising the temperature of the water to the same degrees of heat as the outer air when the sweating will cease.

BRAKE "CREEPING ON."

216. S. H., Charleston, W. Va., writes: What causes the brake on an engine to apply when the brake valve, or both brake valve handles of the E. T. brake are in running position? A.—Brake pipe leakage. We have answered a great many questions on this subject, but will nevertheless give a method of reasoning that can be used to advantage in locating the cause of disorders of this kind. Referring to the No. 6 E. T. brake, if the brake is applied from air pressure in the brake cylinders, we know that the application piston has moved to application or lap position, closing the brake cylinder exhaust, otherwise any pressure entering the cylinders would escape to the atmosphere. The only way the application piston can be moved from release position is by pressure in the application cylinder. The only way air pressure can enter the application cylinder is from an application of the independent or automatic brake. When the equalizing valve of the distributing valve is in release position the application cylinder is open to the atmosphere through the brake valves, and any leakage into this cylinder or its connections, will escape at the automatic brake valve exhaust port, hence if the brake applies while the brake valves are in running position, the equalizing valve must have moved away from its release position. Once the equalizing valve reaches release position it will, as a general proposition, remain there forever, unless a difference in the pressures surrounding it, is created. This difference in pressure causes the application, and the pressure chamber air must increase or brake pipe pressure decrease if a movement of the equalizing valve is desired, therefore if there has been no overcharge of the pressure chamber, the brake pipe feed valve must have permitted brake pipe leakage to create a differential of pressure in the distributing valve. Any trouble of this kind is overcome by applying a sensitive feed valve and stopping the leakage.

ESCAPE OF AIR PRESSURE.

217. Subscriber, Baltimore, Md., writes: On page 178 of the May issue of RAILWAY AND LOCOMOTIVE ENGINEERING, I notice a table showing the number of cubic feet of free air that will escape per minute from various pressures and different sized openings, to the atmosphere. Will you kindly give me the formula that was used in calculating when those results were found? A.—The table you refer to was not prepared by any mathematical calculation, the escape of air pressure from the various sized openings was carefully measured and the results placed in this tabulated form.

Method of Applying Oil Paint.

The surface is given one coating of linseed-oil varnish, to which is added a first coat of white lead when the varnish is dry. A second soat is then added, also containing white lead together with more or less coloring matter, as the building laws forbid the use of absolutely white paint on the exterior of structures. In this climate the use of oil paints is recommended, as they are waterproof and present smooth surfaces which attract a minimum of dirt. Painting according to this method costs here about 10 cents per square yard.

Applied to iron, linseed-oil varnish when used by itself flakes off readily. It should be thoroughly mixed with red oxide of lead, caput mortuum, or ocher graphite. This mixture serves as a first coat after the perfectly clean and dry surface has been gone over with the ordinary hot linseed-oil varnish. When the dead color has dried, another coat of the color desired is applied. The oil, being partly converted into resin, combines with the coloring material.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances.

Published Monthly by

ANGUS SINCLAIR CO.

114 Liberty Street, New York.

Telephone, 746 Rector.
Cable Address, "Locong," N. Y.
Glasgow, "Locoauto."

Business Department:

ANGUS SINCLAIR, D. E., Prest. and Treas.
JAMES KENNEDY, Vice-Prest.
HARRY A. KENNEY, Secy. and Gen. Mgr.

Editorial Department:

ANGUS SINCLAIR, D. E., Editor.
JAMES KENNEDY, Managing Editor.
ALLEN G. WOOD, Consulting Engineer.
GEO. W. KIEHM, Associate Editor.
A. J. MANSON, Associate Editor.

Boston Representative:

S. I. CARPENTER, 643 Old South Building, Boston, Mass.

London Representative:

THE LOCOMOTIVE PUBLISHING CO., Ltd., 3 Amen Corner, Paternoster Row, London, E.C.

Glasgow Representative:

A. F. SINCLAIR, 15 Manor Road, Bellahouston, Glasgow.

SUBSCRIPTION PRICE

$2.00 *per year,* $1.00 *for six months, postage paid in the United States, Canada and Mexico. For other parts of the world,* $2.50, *or ten shillings. Single copies,* 20 *cents. Remit by Express Money Order, Draft, Post Office Order or Registered Letter.*

Mailing address can be changed as often as necessary—always give old and new address, and if you subscribe in a club, state the name of the agent.

Please give prompt notice when your paper fails to reach you regularly.

Entered at the Post Office, New York, as Second-class Mail Matter.

Statement of Ownership and Management of Railway and Locomotive Engineering, *published monthly at New York, N. Y., required by the Act of August 24, 1912.*

Editor, Angus Sinclair, 114 Liberty St., New York, N. Y.

Managing Editor, James Kennedy, 114 Liberty St., New York, N. Y.; Business Manager, Harry A. Kenney, 114 Liberty St., New York, N. Y.; Publisher, Angus Sinclair Co. (Inc.), 114 Liberty St., New York, N. Y.; Owners, Angus Sinclair, 114 Liberty St., New York; James Kennedy, 114 Liberty St., New York; Harry A. Kenney, 114 Liberty St., New York; Mrs. Otto J. Schonbacher, 40 Heddon Terrace, Newark, N. J.

Known bondholders, mortgagees and other security holders, holding 1 per cent. or more of the total amount of bonds, mortgages, or other securities: None.

Harry A. Kenney,
Gen'l. Mgr.

Sworn to and subscribed before me this second day of October, 1912.

Oliver R. Grant,
Notary Public No. 78, New York County. Commission expires March 30, 1913.

Boiler Inspection.

Although little more than a year and a half has elapsed since the passing of the Boiler Inspection Act, the beneficent results of the wise measure are already apparent to the most casual observer, and a ready compliance with the details of the Act is observable among all interested. Not only are the accidents arising from defective boilers less in number, but there is a spirit of unanimity in the means and methods of inspection and repair of boilers, that cannot fail to still further the safety and efficiency of boilers.

A fine feature of the operation of the law is the fact that the inspectors all rank high as mechanical men of large experience. Of the fifty inspectors now engaged under the Chief Inspector of locomotive boilers, every one has seen service in responsible positions in relation to the construction and repair of locomotive boilers, and one of the requirements was that no one should take the examination who had been away from railroad service longer than two years. As a result it is universally admitted that the Inspectors are high class representative mechanical men.

It will be remembered that the Act was the outgrowth of a resolution adopted at the Los Angeles Convention of the Brotherhood of Locomotive Engineers in 1904, and although it took seven years to bring about an enactment it was no fault of the Grand Chief Engineer, or those associated with him in this good work, but the delay was caused by the fact that there is such an enormous mass of bills submitted to Congress that only a small fraction of them ever reach even the smallest amount of consideration; so that in comparison with other measures the Boiler Inspection Act came into operation with a degree of rapidity beyond the expectation of those familiar with Congressional legislative methods.

The sections of the Act are being constantly amended and added to and it should be the duty of every one in any way connected with the cleaning and repairing as well as with the inspection of boilers to become familiar with the provisions of the measure. It is the best expression of the best thoughts of the most experienced men on the subject; and the members of the Interstate Commerce Commission gladly welcome any suggestions looking toward the perfecting of the measure. Last month two important amendments were made on rules 29 and 35, so that the former now reads that "Every gauge shall have a siphon of ample capacity to prevent steam entering the gauge. The pipe connection shall enter the boiler direct and shall be maintained steam tight between boiler and gauge. The siphon pipe and its connections to the boiler must be cleaned each time the gauge is tested." The latter amendment refers to the setting of safety valves, and states that "Safety valves shall be set to pop at pressures not exceeding 6 pounds above the working steam pressure. When setting safety valves two steam gauges shall be used, one of which must be so located that it will be in full view of the person engaged in setting such valves; and if the pressure indicated by the gauges varies more than 3 pounds they shall be removed from the boiler, tested, and corrected before the safety valves are set. Gauges shall in all cases be tested immediately before the safety valves are set or any change made in the setting. When setting safety valves the water level in the boiler shall not be above the highest gauge cock."

These two amendments become effective on and after January 1, 1913, and while rule 29 does not seem to convey much that is not in general practice, it emphasizes and makes clear the use of a siphon pipe, and also its connection directly to the boiler instead of being connected to chamber or header as is sometimes the case. Rule 35 is a distinct and new departure from common practice, and while at the first glance it may seem superfluous to have two gauges while adjusting the safety valves it is obviously in the line of safety. The writer recalls numerous occasions when adjusting safety valves that there was a tendency on the part of the assistant in the locomotive cab who had the opportunity of observing the gauge and calling out the record, to drop one hundred, and instead of stating fully 150 or 160 as the case may be would lazily call 50 or 60, assured that the "hundred" would be understood. Of course, any mechanic of experience would know the variation on the pressure of the wrench, as well as the blast of the escaping steam on pressures of 50 or 150, but possibly something of this kind occurred in the appalling disaster at San Antonio, Tex., which resulted in such a disastrous explosion and when the safety valves were found to be screwed down as far as the thread of the studs would allow, and probably a pressure between 300 and 500 pounds had accumulated in the boiler on account of the carelessness or lazy stupidity of some unskilled worker. The pressure of a gauge before the eyes of those who may be adjusting the safety valves is a step in the right direction, and will be soon fully appreciated by all who have at heart perfection in detail looking towards increased safety in operation.

A recent address delivered before the members of the Southern and Southwestern Railway Club at Atlanta, Ga., by Mr. John F. Ensign, United States Chief Boiler Inspector, is perhaps the most lucid exposition yet given in the subject of locomotive boiler inspection, and a series of questions to which Mr. Ensign made copious replies showed how thoroughly he had conned the subject, of which he has taken pains to become the highest living authority, and a copy of his excellent lecture, if it were possible, should be in the hands of thousands of mechanical railway men whose work is largely guided by a thorough knowledge of the enactment.

Want of space prevents us from tak-

ing up more of the details of the rules so far in operation at present, but we shall refer to the matter from time to time, and especially in regard to any new clauses that may be added, to the end that our readers may be kept informed of these changes.

Railroad Mechanical Progress.

It is frequently a matter of bitter complaint among inventors and promotors of mechanical devices intended for use on railways, that it is almost impossible to secure opportunities for a fair trial of new appliances, and that there is a settled determination among leading railway men that it is better to bear the ills they have than fly to others that they know not of. This is a gross error. Inventors should be patient. All real progress is necessarily slow. If a parallel might be made in regard to buildings, it will be universally admitted that steel is the best material adapted for durable structural work, but if a house is already built of wood or brick or stone, it is too much to ask that the owner should immediately pull down the structure and rebuild it of more approved material. Apart from the mere question of cost there is the more important question of utility and allowing what is in use to completely serve its purpose until it has outlived its usefulness. Railroad men are looking for new improvements all the time, but work cannot be stopped on a busy thoroughfare for the sake of some untried experiment.

As a matter of fact tests are being constantly made that involve much expense, and results are being tabulated with a degree of accuracy hitherto unapproached. This is the only real road to progress. Indeed, if the claims of inventors were to be taken at their face value, a sudden transformation of existing conditions would be made that might lead to red ruin, for out of a hundred inventions full of promise, there are not over four per cent. that blossom with real merit. It is the same in every department of human endeavor, out of a hundred books published, only four reach a second edition, and of these four perhaps not one takes a permanent place in literature. Out of this mass of matter an occasional flash of truth comes, and, like the dawn breaking through a mist-mantled landscape, by and by a glorified mountain peak appears and slowly but surely takes its place among the landmarks.

In railroad work the present year has been full of valuable experiment and the results are full of promise. Among these Wireless Train Control, to which we called the first special attention in the early part of the year, and which is receiving marked attention from leading railway men all over the world, bids fair to come into permanent practical use. Important tests of new forms of fireboxes have been made that may lead to important changes in the structure of steam boilers generally and locomotive boilers particularly. As we pointed out recently a real advance may have been made in the perfection of a reliable device giving warning in the case of low water in boilers. The universal introduction of a simple and effective device of this kind would be a real gain and doubtless avoid such disasters as may arise from low water in boilers. It may be added, however, that ruptures in boliers arising from this cause are apt to be exaggerated in number. Last year the British Board of Trade reported that only 16 per cent. of boiler explosions could be directly traced to low water, the chief causes of failure being attributed by the Board to corrosion, overpressure or decayed sheets, imperfect or utter lack of repairs, and other causes. In America generally nearly all boiler explosions are looked upon as being brought about by allowing the water to become low in the boiler. A controversial point of this kind is under any condition difficult of settlement, and even an exact decision would not provide a remedy, but a perfected device pointing unerringly to low water would be a real gain.

Among recent tests of locomotives the Buffalo, Rochester and Pittsburgh Railway has shown a degree of enterprise and earnestness eminently praiseworthy. The company's locomotive equipment has recently received important augmentations and careful tests have been made between Atlantic, Consolidation, Mikado and Pacific types of locomotives. These equipped with superheaters and brick arches have been tested against the same kind and size of locomotives without the appliances referred to and the result is so convincing that there is no room for further controversy in regard to the utility and marked economy of the use of these devices when properly applied and intelligently operated.

Energy and Power.

During the last thirty years, an entirely new aspect has been given to mechanics, says Professor Reynolds, by the general recognition of the physical entity which we call energy in different forms.

We recognize one thing under different forms in the raised hammer, the bent spring, the compressed air, the moving shot, the charged jar, the hot water in the boiler, and the separate existence of coal, corn, or metals, and oxygen. We see in the revolution of the shafts and the travel of belts in our mills, the passage of water, steam, and air along pipes, the conveyance of coal, corn, and metals, and the electric currents, the transmission of this same thing—energy—from one place to another; and in all mechanical actions we perceive only the change of form in the same thing.

Taking this general or energy point of view, we may get rid of all the complications arising from special purpose, and recognize nothing but the source of energy in its source, the distance it has to be transmitted, and the special form that must be given to it for its application. And this view, although not the best in which to study the special purpose of mechanics or contrivances, is of great importance, inasmuch as it has revealed many general laws, and many fundamental limits to the possibilities of extension in certain directions.

Although the terms energy and power are in continual use, such use is seldom in accordance with their scientific meaning. In many ways the conception of energy has been rendered popular, but a clear idea of the relation of energy to power is difficult. This arises from the extreme generality of the terms; in any particular case the distinction is easy. Power may be considered as directed energy; and we may liken many forms of energy to an excited mob, while the directed form of power is like a disciplined army. Energy in the form of heat is in the mob form; while energy in the form of a raised hammer or a raised weight, matter moving in one direction as the electric current, is in the army form. In one case we can bring the whole effect to bear in any direction, while in the other case, we can only bring a certain portion to bear, depending upon its concentration.

Some Revolutionizing Inventions That Didn't Revolutionize.

Sundry suggestions have been made of late as to the expediency of establishing museums of early railroad devices for the benefit of posterity. A national collection of this class of mechanical curiosities, showing the rude beginning of the present marvelous development of railroads, would be highly instructive as well as diverting. Without going back to primitive things, such as the "Tom Thumb" engine and other antiquities of that period, a very interesting catalogue of mechanical curiosities might be compiled from the records of technical journals in this country within the past thirty years. Some of these were of the "revolutionizing" kind—ambitious projects that successively burst upon the world like meteors, and after attracting much attention for a time, as suddenly disappeared and were thought of no more, or were remembered only as conspicuous failures. These fiascos should have a place in the proposed museums, either in the form of drawings or models or a descriptive record. Could all of them be recalled from oblivion, their number would be quite surprising, and a study of them would inspire a wholesome distrust

of the many new schemes that are constantly being devised for superseding what has already stood the test of utility and practical service. We will advert only to a few sample specimens relating more or less directly to the economies of railroad operation.

The first in the order was a new fuel, the invention of Mr. S. C. Salisbury, of New York. It was said to be a residuum of petroleum and coal tar, mixed to the consistency of molasses and atomized by contact with a current of super-heated steam, when it was discharged in the form of a fierce and delicate spray into the blazing furnace, and generating a heat that melted pig iron in ten minutes; and what was most wonderful, this intense heat, estimated at 8,000°, was generated in total darkness. Highly satisfactory experiments, according to reports, were made with it in the same year at the Brooklyn Navy Yard, the result being followed by the announcement that the city of Pittsburgh, on account of its nearness to the oil regions, was to run 300 blast furnaces with the new fuel and become the greatest manufacturing city on the globe, and that ocean steamers were to be entirely relieved of coal freight and save thereby $5,000 a trip.

The following year witnessed the advent of the Prosser Twin-Cylinder Car, which was to revolutionize the transportation of grain by carrying it in two enormous cylinders made of boiler iron, each cylinder holding as much as an ordinary box car, and revolving on an axle running through the center, upon the ends of which were the journal boxes. Tires, flanged and fitted to the gauge of track, were put round the cylinders and were the wheels of the car. The car was run on the C. B. & Q. road making six round trips of 200 miles, carrying the grain magnificently, and turning it out at the end of the trips a grade better than when it was received. Conductors and yardmasters were delighted with it. There was said to be no trouble in passing curves, frogs and switches, the draft was easy, there was less friction and dead weight, a lower center of gravity, less lubrication and wear of track; and, furthermore, the car was fireproof, and, according to report, one locomotive could haul as many of the cars as could be put behind it. And yet the thing was not a success, and didn't revolutionize grain transportation to any appreciable extent.

The well known Miltimore compound car axle with an independent wheel motion, after many improvements had been made in its construction, was perfected in 1879. It was a very complete piece of mechanism, and the numerous tests to which it was subjected were attended with highly satisfactory results as compared with rigid wheels and axles. So far as could be demonstrated by performance, it was a safe device, with little or no danger of breakage or heated journals; there was no leakage of oil, an extremely small quantity of lubricant was required, the wheels made double the mileage of rigid wheels, there was scarcely any flange wear, the cars ran easier and steadier, wheels could be used on the same axle without being accurately mated and without any increase of wear or draft power, and a wheel could be taken off and replaced in an hour without going to the shop. Yet no running tests, however favorable, could eradicate from the minds of railroad men the distrust of complication and piece work inseparable from all independent wheel movements, and this labored and costly attempt to do away with rigid wheels proved a failure. It could not even get a permanent foothold on the elevated lines of New York City, where such a device was especially needed on account of the exceeding sharp curves.

The next phenomenon was the famous Fontaine locomotive, which appeared in 1881, and for a time seemed to be a notable advance in locomotive construction, so far as the testimony in regard to its performance was entitled to any weight. It had upper and lower driving-wheels, the power being applied to the upper ones, and the cylinders placed at an angle for the purpose. It ran on the Canada Southern road several months, hauling seven passenger cars at the rate of a mile a minute, and ordinary freight trains as economically and satisfactorily as with larger engines of the usual type. Yet it was constructed upon an irrational theory, and in violation of one of the fundamental principles of mechanics. It was claimed by its projectors, however, as a success so far as fast running with comparatively light trains is concerned, and that its ultimate failure was due to breakages caused by bad construction and poor material, and a prejudice on account of its excessive height and the difficulty of handling it with the ordinary shop appliances.

In the same year the wonderful "hydrocarbon" locomotive was heralded to the world by columns of newspaper puffery and extravagant assurances that it was to revolutionize the motive power of the world. It was built for the projectors by the Grant Locomotive Works, and was to generate and burn hydrogen gas from water by the Holland process, saving 90 per cent. of the cost of coal consumed by ordinary locomotives. It had 2,174 copper flues and a fire-chamber with 352 burners. The combustion was of such an unusual kind that the greater the heat and ratio of evaporation, the smaller the minimum of cost in fuel. Months of preliminary experimenting and testing had made success a dead sure thing. A trial trip was made with the engine on the Newark branch of the Erie road, where it hauled a "full-fledged passenger train" 19¾ miles. The last we heard of it was its performance at the Chicago Exposition of Railway Appliances, in 1883, contaminating the atmosphere with its fumes, making it quite impossible for anybody to ride behind it, no matter how much the economy in fuel might be.

Another revolutionizing invention of a more recent date, was a "cylindrical steel passenger car," which was in course of construction by the Robbins Cylindrical Car Co., of Boston, and about half completed in July, 1884. The builders published an elaborate picture of it, and a descriptive circular setting forth its superiority over wooden cars in numerous details relative to the requisites of safety and economy. The cost was to be no more than that of a wooden car of the same capacity, and the weight from four to eight tons less. Postal, baggage and freight cars were also to be built on the same general plan. So far as we know, this car may have been completed and possibly may now be running on some of the New England roads and realizing the most sanguine expectations of its designers and builders. If so, the matter has for some reason been kept remarkably quiet.

Another of this class of inventions, and the last that we shall now refer to, was, or is, a three truck freight car, or a car with a central supporting truck to increase the carrying capacity without increasing the weight of the body structure. If we mistake not, a number of cars of this description have been built and put in service with very satisfactory results. They were in use some years ago on the Iron Mountain & Southern, and more recently, we think, on some of the Northwestern roads. If the reinforcing center truck really serves the purpose for which it was intended, and there are no drawbacks in running to offset the theoretical advantages, such cars ought to be more extensively used in these days, when it is so desirable to carry increased loads without adding to the weight upon each journal or increasing the size of axles.

Wear of Driving-Wheel Tires.

Where the feed-water provided for the locomotive boilers on a railroad is fairly free from the impurities that deposit scale or mud, an engine can be run with trifling expense for repairs and cause no delay in having them done, till the tires need turning. To turn a set of tires is not necessarily a heavy or expensive operation, but it causes the engine to be taken into the shop for a few days and if this happens, when traffic is crowding the operating department the loss of the engine is an inconvenience. A set of tires that will run twice as long between turning as another set thus becomes an important element in reducing the expense

of repairs, and often keeps an engine in service when the extra work done is worth far more than the price of first class tires. This being the case, master mechanics are naturally anxious to use tires that will make long mileage without turning, but there is great diversity of opinion as to what condition will prolong the life of tires by reducing wear and tear. On no subject connected with locomotive engineering do we find railroad mechanical men more disposed to talk or to ask for suggestions. There is no disposition to abuse tire-makers for producing an inferior article, as there is with those who are intimately interested in the wear of steel rails and blame the makers for supplying steel mixed with cinder, but there are many complaints about the tires not wearing longer than they do. The circumstances connected with the wear of tires are often of a nature to puzzle the observer. A master mechanic who devoted careful attention to the tire question, mentioned a curious performance of a set of tires. The engine was on heavy passenger service and was run continually by one engineer. The tires were put on in the beginning of winter, and ran close on two years before they needed turning, having made about 18,000 miles to each 1/16 in. of wear. At the end of another year the tires had to be turned with about 8,000 to the 1/16 in. of wear. After that the engine made about 20,000 miles to the 1/16 in. of wear for the remainder of the life of the tires. There was no extra work done during the period the tires wore fast, and the same man held the throttle. Of course this is a striking instance of the "uncertain in locomotive engineering," but there was a cause for the rapid wear if it only could have been discovered, and it would be a good work in the cause of knowledge if those who come in contact with "mysterious" cases of this kind would display energy and ingenuity in finding out their origin.

Complaints that we have heard made about the tires of certain locomotives wearing badly in comparison to others are susceptible of easy explanation. Tires wear in two ways. The weight of the engine pressing upon the drivers leads to abrasion of the surface coming in contact with the rail, and as the wheel rolls round, the tire wears away by the minute particles dropping off. That is the wear of rolling friction. The second method of wear is that of sliding friction, where the slipping of wheels on the rails grinds away the tires, as an emery wheel wears away the surface from any article put in contact with the revolving face. The sliding friction, where it comes much into action, is by far the most disastrous to the life of locomotive tires. Inordinate slipping of driving wheels result from two leading causes—very hard tires and too little weight on the drivers. The art of making steel tires is so highly perfected that tires too hard for economical service are rarely produced. When an engine is noted for slipping badly, the cause is nearly always that the cylinders transmit too much power for the adhesive weight upon the drivers. The engineering world has never discovered or settled upon a limit of the weight that can safely be placed on driving-wheels, but a few years ago Mr. Chanute and a few other engineers insisted on limiting the weight on each wheel to 12,000 pounds. This teaching for a time exerted powerful influence on the designing of our locomotives, and its effect is still apparent on many roads. The weight was insufficient for engines with cylinders larger than 15 by 24 ins. with drivers five ft. in diameter, but many large cylinder engines were built with the weight on the drivers little beyond the limit mentioned.

Slippery locomotives and the attempted remedy of a stream of sand constantly dropping on the rails, will always be found on a road or division where the tire mileage is low. While investigating this subject we obtained some carefully collected statistics relating to the wear of tires on different classes of locomotives. The information gave the capacity of the cylinders the size of driving wheels and the weight upon them, the kind of service the engine was employed upon, and the mileage made per 1/16 in. of tire wear. The figures indicated that the man at the throttle had a good deal to do with the conservation or destruction of tires, a matter which most master mechanics are perfectly competent to deal with, but on the whole the tire wear was in the inverse ratio to the weight on the driving-wheels. The case of two classes of eight wheel freight engines running on one division and doing similar service may serve as a specimen of the whole. All the engines had driving-wheels 57 ins. in diameter. The first class had cylinders 17 by 24 ins. and 28 tons on the driving-wheels. They ran an average 9,476 miles per 1/16 in. of tire wear. The second class of engines had cylinders 18 by 24 ins., and the weight on the drivers was 26 tons. They made an average of 2,945 miles per 1/16 in. wear of tire.

When a master mechanic is troubled with unequal wear of tires, he should classify his locomotives, showing the tractive power of cylinders and the weight on drivers. Where this is done valuable information will nearly always be obtained if the tire wear was carefully ascertained.

Growth of Justice Sentiment in Russia.

Russia which has always been notorious for the harsh treatment of labor seems to be improving matters under the operation of the Duma, as the parliament is called in that country. Last year the Ministry of Finance introduced a law intended to ascertain the loss of health or working ability caused by industrial accidents. This law concludes a whole series of legislative measures regarding compensation to workmen and persons employed in various industries. Much to the surprise of the Russian public, the law was approved by the Duma, the Imperial Council and the Emperor.

The bills concerning the insurance of workmen against accidents and providing for them in case of illness, introduced by the Ministry of Trade and Industry as far back as 1908, were accepted by the Duma in two readings.

Among other bills relating to labor legislation and under discussion in the Duma during 1911 was the proposition to abolish criminal punishment of employees who leave their work before the expiration of their term. The idea of abolishing this law was taken up as far back as 1906, after the abolishment of criminal punishment for strikes, and met with general sympathy. The representatives of industry, a great number of whom took part in the sessions of the labor committee of 1906, unanimously favored abolishing this law, which was hardly ever enforced. The measure met with no objection in the Duma, but was unexpectedly delayed in the Imperial Council.

Simplicity of Machines.

There have been several peculiarities observed in the development of machines that have had their counterpart in the locomotive engine. The controlling aim of an original inventor is, to make the apparatus he is engaged upon operate. The first production then is, as a rule, a crude device. Then he or others proceed to its elaboration with the view of increasing the efficiency or developing its self acting properties. This line of would-be improvement is nearly always pursued, until a condition of complication is reached which demands radical remedies. Then the improvers return to first principles and the fittest machine is developed.

The locomotive engine passed through this process to a remarkable extent. It was first composed of merely the driving element, and these were gradually expended by the addition of attachments intended to promote efficiency, until it became a remarkably complex engine, constantly liable to failure through breakage of its numerous parts. Baldwin was the first locomotive builder to realize the advantages of simplicity, and he worked into designs which provided the foundation on which the modern locomotive is built.

It is a noteworthy fact that the most popular form of steam engine in use on river boats is the original form of Watt's engine, that of a pivoted beam. In simplicity and durability it is not surpassed by any modern improvement.

Air Brake Department

Operation of L. T. Brake.

A knowledge and strict observance of the rules for operating an air brake will avoid many undesirable actions that are sometimes manifest in every day service. The results of incorrect manipulation are readily demonstrated on a test rack or with a train of cars on the road, but if the brake is properly cared for and used as recommended, it will do just what the manufacturers claim for it.

With the operator, the rudimentary knowledge is the correct use of the positions of the brake valve handles, and we will not attempt an explanation of the reasons for each recommendation, but there are very important reasons for each suggestion that will follow, as an example, the first instruction for operating the automatic control equipment is, "When not in use, keep handle of automatic brake valve in running position and handle of straight air brake valve in release position. This is, of course, the running position of the brake valves, but there are special reasons why it should be adhered to, for with large capacity air compressors maximum brake pipe pressure is sometimes accumulated against a leakage that the feed valve or pressure controller cannot maintain, then an attempt may be made to get the train over the road by carrying both brake valves in release position, and if the train should be parted a considerable portion of it may be lost en route.

This possibility is avoided by observing instructions, that is, reducing the leakage to a point at which the pressure controller should be able to maintain it; then carry the valve handles in their proper positions.

The following recommendations without any particular explanation have reference to the New York L. T. brake equipment.

For service application, move handle of the automatic brake valve to service position until the required reduction is made, then back to lap position, which is the position used to keep the brakes on.

To release the train brakes, move handle of the automatic brake valve to release position; if the locomotive brake is to be released immediately afterward, bring the handle to running position, but if it is desired to hold the locomotive brake applied for a time, move from release to holding position, then graduate off as desired by short movements between holding and running positions.

How long to hold the automatic brake valve in release position depends principally upon the length of train, capacity of the air pump and the volume of compressed air in the main reservoir. Leakage in the brake system and grade of track also enter in a lesser degree.

How long the brake valve remains in holding position depends principally upon the length of train, speed and grade.

For emergency application, move the handle of the automatic brake valve to emergency position and leave it there until the train is brought to a stop.

The desirable two-application stop for passenger service is very easily made with the automatic control equipment. Use the automatic brake valve and make the first application strong enough to reduce speed to about fifteen miles per hour; then move handle to release position and immediately return to running position for two or three seconds before making the second application of the brakes.

With passenger trains of less than 10 cars, and where the grade conditions will permit, the final release should be made by moving the handle to release position and immediately returning it to running position with the object of getting the train and locomotive released by the time the train is stopped; with 10 or more cars, hold the brakes on until the train comes to a stop.

When the straight air brake is used alone, carry automatic brake valve in running position and release the straight air brake, when desired, by moving the handle of the straight air brake valve into release position.

With long trains, careful operation of the straight air locomotive brake is necessary to avoid injury to cars and contents, by bunching slack too suddenly or letting it run out with a jerk.

If emergency conditions occur while the straight air brake is already on, immediately set the automatic brake also and the safety valve will keep the brake cylinder pressure within safe limits.

On heavy grades, use the locomotive and train brakes alternately, so that the tires of the driving wheels will not become overheated, and that the pressure retaining valves may have assistance in controlling the train while the auxiliary reservoirs are being recharged.

To use the locomotive and train brakes alternately in this manner, proceed as follows: When train brakes are set, use the straight air brake valve in automatic release position to keep the locomotive brakes off; then apply locomotive brake and immediately release the train brakes. After again applying brakes on the train, release the locomotive brake with the straight air brake valve, as explained above.

If all brakes have been automatically applied in the usual manner and it is desired to only release the locomotive brakes either wholly or gradually, this can be done with the straight air brake valve in automatic release position.

In operating this equipment, observe the pressure obtained in the locomotive brake cylinders, as shown by the red hand of the gauge connected to them.

The independent or straight air brake is a very effective and desirable safety provision, and is capable of holding on ordinary grades, a train of the usual tonnage handled on such grades, after the train has been brought to a stop and the slack is all in. It is always advisable, however, to have the automatic brake in condition to apply also, should anything occur to make this necessary, and to set hand brakes whenever it seems advisable.

When the engine is standing at a water crane or coal chute, or when working about it the straight air brake valve should be left in the applied position.

If the brakes are applied by parting of train or burst hose, or if the brakes have been set with the conductor's valve, the automatic brake valve must be placed in lap position.

Lap position is for use only in holding the brakes applied, and should be used at no other time, and the handle should never remain in lap position an instant longer than is absolutely necessary.

The idea is to have air pressure flowing into the brake pipe for the maintenance of auxiliary reservoir pressure during every instant of time that this is possible.

In connection with the use of lap position of the automatic brake valve, it may be well to refer back to the instruction for applying the brakes, which is, "move the handle of the automatic brake valve to service position." It will be noted that it does not read, "move the handle to lap position until the place at which the application is to be made is selected."

There are excellent reasons why these rules should be strictly observed, both as to the valve handle remaining unnoticed in lap position and to the unnecessary use of lap position just previous to an application; the former is liable to result in a runaway on grades or a loss of train control, and the latter abuse of lap position is very liable to produce the

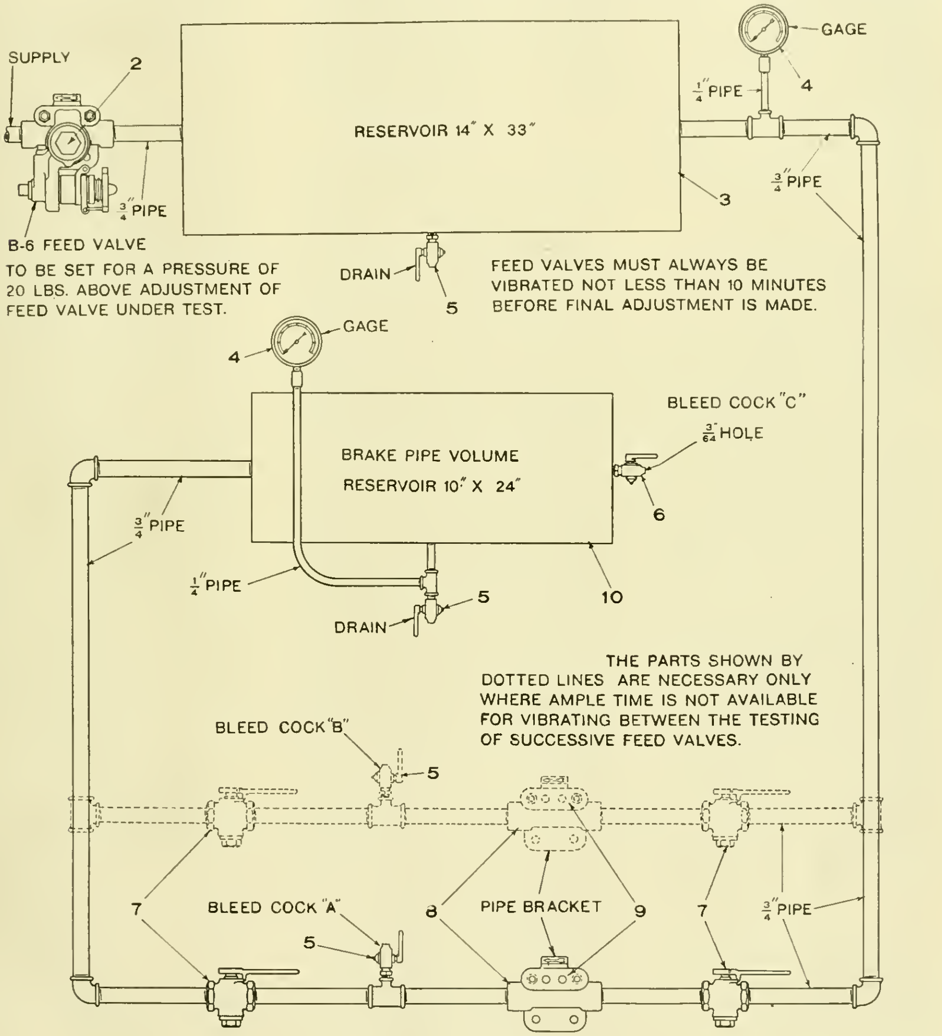
undesired quick action of the brake.

Many an engineer has come to grief through a disregard of the proper use of this position; that is, has allowed the handle to remain in lap position when it should have been in running or service position.

If more than one locomotive is attached to a train, all except the one from which the brakes being operated must have the cut-out cock closed in the brake pipe under the brake valve, and the handles of the brake valves carried in running position.

Always try both brake valves before leaving the roundhouse, and make sure that there are no leaks of importance. All pipes connecting the automatic brake, straight air brake valve and control valve must be absolutely tight.

When trying the brake valves, know that the brake can be released with the straight air brake valve when the automatic brake valve has been used to apply them and is returned to lap position. This will insure a release of the engine brake, under any condition of service, if desired.



FEED VALVE TEST RACK.

Feed Valve Test Rack.

The article on the excess pressure governor top will tend to emphasize the importance of a thorough and reliable test for the brake pipe feed valve.

This issue contains a photographic view of the Westinghouse feed valve test rack. The code of tests will be furnished with the device which we hope to again refer to in a future issue.

Excess Pressure Governor Top.

One of the most valuable, and certainly one of the least appreciated features of the E T brake equipment, is the automatic regulation of main reservoir pressure. The excess pressure head of the S. F 4, S. F 5, and S. F 6 pump governors not only provides for a main reservoir pressure that remains at a fixed figure above the brake pipe pressure, regardless of any variation in it, but under many desirable conditions the governor top controls the pump or pumps to a

moderate rate of speed when, without this type of governor, the pumps would run at top speed. In running position of the brake valve, the spring chamber above the diaphragm portion of the excess pressure head is directly connected with the brake pipe, and any drop in brake pipe pressure will weaken the pressure that is assisting the regulating spring in holding the diaphragm valve to its seat, and if main reservoir pressure can remain at a figure 20 lbs. or more in excess of the falling brake pipe pressure, the pump or pumps will be stopped until the pressure above the diaphragm is restored to a figure within 20 lbs. of main reservoir pressure at which time the diaphragm valve will be seated and the pumps will be allowed to start. For a complete demonstration of the action of this governor it is only necessary to pump up the air pressure on a locomotive and with the brake valve in running position, open an angle cock in the brake pipe and note the results. The pumps will not start until the pressure in the main reservoir falls to about 40 lbs., then they will work just fast enough to supply the volume of air escaping through the feed valve. If the pumps are started with the angle cock in the brake pipe open, the brake valve being in running position, about the same pressure will be compressed in the main reservoir and the pumps will run just fast enough to supply the volume of air that is escaping.

Naturally this is the only thing that can occur as the brake pipe is open and there is no air pressure above the diaphragms of the excess pressure head, and as soon as main reservoir pressure becomes strong enough to force the governor piston down and close the steam valve, the pumps will be stopped or controlled to the speed required.

Those who are inclined to jump at conclusions may have found considerable fault with this type of governor, but it has in the aggregate, saved many thousands of dollars in the purchase of air pump repair parts which will, from the standpoint of cost of maintenance justify its use, however, if some of the features sometimes thought to be unnecessary, are carefully considered, any cost of maintenance will be found to be of secondary importance.

In coupling to a train of uncharged cars, the proper position for charging the train is release position so that the fall of main reservoir pressure and the starting of the pumps will be prompt, and the governor cannot affect the operation of the pumps until after the desired brake pipe pressure is accumulated.

When the brake valve is returned to running position, the feed valve must maintain the brake pipe pressure against leakage or the pumps will be stopped by the action mentioned.

Now no matter how this action may be regarded, the fact remains that the engineer can turn this to a decided advantage to himself.

Under ordinary circumstances, he should never leave a terminal with his brake valve in release position unless descending a heavy grade should necessitate it, and if the train is charged in release position and the pumps are stopped every time the brake valve handle is brought to running position, proving that the escape of air from the brake pipe is in excess of the capacity of the feed valve, the leakage should be stopped, or if the fault is with the feed valve, it should be corrected before attempting to handle the train.

It is not necessary to open an angle cock to note the escape of air pressure in an effort to determine whether the feed valve is defective or whether the leakage is excessive. If the brake valve handle is placed on lap position until 90 or 100 lbs. is compressed in the main reservoir and then returned to the running position, the rate of fall in main reservoir pressure will show the condition of the feed valve so far as its ability to deliver the air pressure is concerned.

The rate of fall of main reservoir pressure through the feed valve will of course depend upon the volume and pressure in both the main reservoir, and the brake pipe into which the reservoir pressure is expanding, but with the modern main reservoir volume of from 60,000 to 80,000 cubic inches capacity, under about 100 lbs. air pressure the B 6 feed valve should reduce the main reservoir pressure by flowing into an empty or considerably depleted brake pipe at a rate of from about 30 to 40 lbs. per minute, that is, the main reservoir pressure should drop from 100 lbs. to 80 lbs., or from 90 lbs. to 70 lbs. in from 30 to 40 seconds.

If the pressure drops at approximately this rate it proves the feed valve to be in a condition that will enable it to supply any ordinary brake pipe leakage, and this refers to the B 6 or C 6 valve which should be used in present day service. It will be remembered that the size of compressor is not considered in this test, as it is only made under conditions where the governor stops the pump as soon as the brake valve is placed in running position. In this manner an observation of the gauge will show the condition of the brake pipe as well as the feed valve, and the train should not be moved from the terminal until it can be charged and the brake pipe pressure maintained with the brake valve handle in running position.

In order to do god braking in freight service the amount of brake pipe pressure to be exhausted by the initial reduction must be fixed upon, and it is determined by the length of train, type of brake equipments and track conditions, and if brake pipe leakage is sufficient to tax or exceed the capacity of the feed valve, the amount of brake pipe reduction cannot be regulated by the engineer, and he cannot be held responsible for results in stopping trains with excessive brake pipe leakage unless he leaves the terminal with the knowledge that the brake pipe leakage is excessive.

The amount of brake pipe leakage a train is allowed to leave with often depends upon the capacity of the air pump, the 9½ or 11-inch pump, cannot supply air as fast as it can flow through the feed valve under a high pressure, consequently the leakage must necessarily be looked after in many instances before the train can be charged, but with the 8½ C. C., the New York No. 5 or two 11-inch pumps, a figure of brake pipe pressure can be reached against leakage that the feed valve cannot maintain, and if an engineer will leave a terminal point with the intention of running the brake valve in release position, he should expect to be held responsible for the safety of, and any possible damage to the train.

This governor top will not require any additional or added attention, but it should be kept clean and sensitive enough to prevent main reservoir pressure from falling to within 12 or 14 lbs. of the adjustment of the feed valve.

There is also the possibility of a piece of foreign matter lodging on the diaphragm valve seat of either governor top which would throttle or possibly stop the pump, and in the event of any stoppage of the pump the air gauge should always be observed, and if there is more than 20 lbs. difference between main reservoir and brake pipe pressure, it indicates that there has been a decrease in brake pipe pressure or an increase in main reservoir pressure, and that the pumps will start as soon as the pressures near an equilibrium.

If, however, the pump has stopped and the difference between main reservoir and brake pipe pressure is less than 20 lbs., it indicates that the governor is at fault, or that the pump has failed, due to some disorder in itself. It is assumed that the air pressure is at a figure somewhat below the adjustment of the maximum governor head, then if there is a blow or waste of air from the relief port of the governor, it proves the governor to be at fault, but if there is no indication that the governor has stopped the pump, we would at once ascertain whether the pump is receiving an ample supply of steam to run it.

If the engineer makes it his business to notice whether the relief port is open before leaving the engine house, he may avoid a bad half hour of pump or governor trouble along the road.

Should this excess pressure head become defective en route, it will be noticed either by a failure to stop the pump when the desired pressure is attained, in which event the maximum head will con-

trol the pump, or the governor may stop the pump and hold the steam valve closed.

If, with the pressures nearly equal, the pump will not start while the handle is in running position, but will start as soon as the valve is placed in lap position, the handle should be left in lap position long enough to disconnect the excess pressure operating pipe at the brake valve and put in a blind gasket or plug the fitting. This would cut out the excess pressure head and permit the maximum head to control the main reservoir pressure until the proper repairs can be made.

With reference to changing an unusually long, empty or considerably depleted brake pipe, the writer is favorable to a method of using the brake valve between running and release positions, that is, to move the handle just far enough toward release position to open the direct-supply port a sufficient amount to keep the compressors running at a moderate rate of speed.

In concluding we would direct the attention of those of our readers who are locomotive engineers, to the fact that an inability to maintain the required pressure on a train of cars when the brake valve is in running position, may place them in a precarious position if they do not promptly recognize the cause of the failure. If the train crew insists that brake pipe leakage is not excessive, the engineer may be forced to a conclusion that the feed valve is at fault, but before deciding, a test should be conducted to determine the condition of the feed valve and connections. This can be done in a very few seconds times by closing the stop cock under the brake valve and opening the hose at the rear of the tender to the atmosphere, then with the pressures at 70 and 90 lbs., and the engine brake released, the stop cock under the brake valve should be opened and the fall of main reservoir pressure noted.

With the modern main reservoir volumes of 80,000 to 90,000 cubic inches, main reservoir pressure should fall at the rate of about 40 lbs. per minute, or from 90 lbs. to 70 lbs. in about 30 seconds. A considerably slower fall indicates an obstruction, and if this drop in pressure requires 50 seconds or more, it will justify a return to the engine house.

Under no circumstances should an attempt be made to correct a disorder of this kind on a locomotive ready for service, because the trouble is very seldom in the feed valve itself, the obstruction is usually in the pipes leading to or from the feed valve, and sometimes in the brake valve. Even if the feed valve is at fault it is useless to attempt to correct it, as those restrictions are removed by drilling out the brass plugs and port openings, and it is sometimes necessary to force out the supply valve bushing to locate and remove the obstruction.

Should the governor fail to stop the pump during the test it would at once eliminate the feed valve, as this could be taken to indicate that the feed valve pipe pressure was being maintained, and that the restriction was likely to be found in the brake valve.

We mention this for the guidance of the engineer, as in present day railroad service he must be sufficiently well informed to be able to defend himself, the inability to do so is frequently the actual cause of suspension or examination in the instruction car, rather than the offence that is charged.

Curiosities of Track Gauges.

It is amazing the number of track gauges for railways to be found in the world. There is decided advantage to people paying for the construction of a railway to have the track gauge the same as others in use for it saves money in the purchase of rolling stock, but some builders of railways appear to have prided themselves in having something different from other people.

One of the most curious things met with in railway development, is the influences through which certain track gauges were established. The settling upon a gauge likely to prove most convenient for the business of transportation to be done with due consideration as to cost, is an engineering problem which ought to have received careful study and profound calculation. Instead of that the width of gauge has been generally decided by some whim or trifling accident.

In 1840, ten years after the first commercial railway was put in operation, there were 33 separate railways in the British Isles with 1,552 miles of track, and they had five different gauges, ranging from 4 feet 8½ inches to 7 feet, the narrowest gauge having more mileage than all the others. That was George Stephenson's gauge. It was established in a curious way. The pioneer coal carrying railways were run through the fields, and gates were used to prevent the free circulation of livestock. The gateways had just sufficient opening to permit wheels extending five feet to pass through. The wheel flanges in those days were placed outside the tread. When the Stockton & Darlington Railway was built, George Stephenson, who was chief engineer, put the wheel flanges inside. The width of the rail head was 2 inches, so the flange gauge was 4 feet 8 inches. When the Liverpool & Manchester Railway was under construction a few years later, the engineers concluded that it was well to give the wheels free side play to make fast running easy, so they made the gauge 4 feet 8½ inches.

The success of the Liverpool & Manchester Railway and of the locomotive, "Rocket," made George Stephenson, a great man, whom an example was well worthy of imitation, so his track gauge of 4 ft. 8½ ins. was adopted by most of the British railway companies. His son Robert had locomotive building works which supplied many railway companies with motive power, and the track gauge was frequently established to fit the wheels of the locomotives imported. That established the 4 ft. 8½ ins. track gauge on the Continent of Europe and in the United States.

There is still, however, great diversity of track gauges used in different countries. The Baldwin Locomotive Works build engines to the following gauges: 1 ft. 7½ ins., 1 ft. 9½ ins., 1 ft. 11⅝ ins., 2 ft., 2 ft. 6 ins., 2 ft. 6-1/10 ins., 2 ft. 11 ins., 2 ft. 11½ ins., 3 ft. 3 ins., 3 ft. 3¾ ins., 3 ft. 3⅜ (meter), 3 ft. 6 ins., 3 ft. 8 ins., 4 ft., 4 ft. 8½ ins., 4 ft. 9 ins., 4 ft. 9¼ ins., 5 ft., 5 ft. 6 ins.

Science Saved by Saracens.

Among modern people the belief prevails that nearly all intellectual and material progress that make up civilization has been done by the energy of what is known as the Aryan or Indo-European race. There is one notable exception to this.

Under the inspiration of Mahomet, the Saracens, a Semitic race (sons of Shem, to which the Jews belong), shed the light of learning and science over the world when all other races were steeped in profound darkness.

In the intellectual history of the Middle Ages the Saracens performed the most important part. When Europe was sunk in the grossest ignorance, this remarkable people, who had taken possession of Spain, were actively engaged in the cultivation of science, learning and the arts. The schools of Cordova vied with those of Bagdad in the collection of books and the promotion of science, and from them proceeded nearly all that was original in the medicine, physics and metaphysics of Europe during the Middle Ages. They did much to bring to light the records of art and science of the Alexandrian schools and restored to the world the story of how steam was used in the ancient world.

Signalman as Mayor.

British railway men very seldom receive municipal honors, but one exception has been recently made in Crewe, England, where a signalman named Manning has been elected Mayor. Crewe is where the immense machine shops of the London & Northwestern Railway are located, as it is as much a railway town as is Altoona or Susquehanna. The new Mayor manages to attend to his regular duties as signalman and when any extra calls are made on his time by municipal requirements one of his mates is always ready to relieve him. The salary is five hundred dollars a year.

Electrical Department

Electric Operation on the Boston & Maine Railroad.

Electric operation on the B. & M. R. R. has now been in service through the Hoosac Tunnel for over a year with very gratifying results. This section of the main line was electrified to remove the smoke nuisance from the tunnel and also to increase the capacity of the tunnel. About 12½ miles are electrified, nine miles of which is in the tunnel proper.

With steam operation it was necessary to allow only one train in the tunnel at once for each direction due to the density of the smoke, so that the capacity of the tunnel was limited. Since electric operation has been in service, block signals have been installed so that this section of the road is operated as any other section with large increases of capacity.

Due to the short distance of the electrified lines the steam locomotive is not uncoupled from the train but the electric locomotive is coupled at the head of the steam locomotive and the train is taken through the tunnel by the electric locomotive, the steam locomotive doing no work and fires prepared to give a minimum amount of gas and smoke. Our illustration shows one of the first trains which has just passed through the tunnels.

AN ELECTRIC LOCOMOTIVE AND TRAIN AT HOOSAC TUNNEL. BOSTON & MAINE RAILROAD.

Storage Batteries.

In our September number we outlined the history of the electric battery and described in detail many of the most common types of dry and liquid cells in use today. All of the batteries therein described are what is known as Primary Batteries as the electric current is generated by the action of an acid or an alkali on a metal. The capacity of these batteries is very small so that they are used only for bell ringing, signal operation, etc., where only very small currents are required.

There is another type of battery however, which is used where large currents are required and which is known as the storage battery. As the name implies, it is a battery in which the electricity is stored for use later. This type of battery acts like a reservoir so to speak, and does not generate its own electricity as do the Primary Cells.

For many years the storage battery was composed of lead plates in a solution of sulphuric acid. Within the last three years. Thos. A. Edison has developed and built a storage battery known as the Edison Battery which is not composed of lead plates. Owing to the importance of the storage battery in the railroad field, for signals, car houses, etc., we will discribe in detail the construction, operation and care.

Let us first consider the lead storage battery. A complete battery is made up of a number of units or cells, each cell consisting of a box lined with sheet lead, or of glass. The plates are of two kinds, known as the positive and negative which are arranged alternately, there always being one more negative than positive, so that each positive plate is between two negatives. All of the positive plates are connected together and also all of the negative plates so that for each cell there are two terminals, positive and negative. The two sets of plates are immersed in sulphuric acid diluted with distilled water to a specific gravity of 1.15 to 1.30. The acid must be free from impurities and the water must be distilled; otherwise the positive and negative plates will be ruined. This sulphuric acid solution is known as the electrolyte.

The positive plate is of lead, upon which a coating of peroxide of lead has been formed or mechanically applied. The negative plate is of pure lead, the surface of which is spongy or porous.

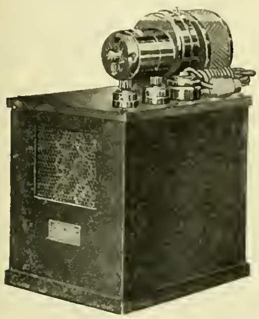
As mentioned above it is necessary with the storage battery to charge or store up the energy. This is done by connecting the battery to a power circuit and electric current flows into the battery. This current is not accumulated as one might suppose, but it causes a chemical action in the battery itself. Electric power is then obtained from the storage battery due to the chemical action being reversed and the plates returning to the original condition they were in before charge.

What takes place in the battery in charge and discharge is this. When the battery is ready for charge both the positive and negative plates contain sulphate of lead. The passage of electric current during charge, from the positive plates to the negative plates, through the solution of sulphuric acid, decomposes the sulphate forming oxide of lead on the positive plate and leaving pure lead on the negative. Sulphuric acid is also formed so that the solution becomes stronger and as will be explained later, forms a means of determining the condition of the battery as to the amount of charge. The battery will be completely charged when bubbles are given off which condition is termed as "boiling."

The battery is now ready to give off electric energy and if the two terminals are connected to lamps, motors, etc., power will be available, and the battery is being discharged. This electric cur-

rent is formed by the breaking down of the lead oxide of the positive plate to lead sulphate and the changing of the pure lead of the negative to lead sulphate. During the discharge the sulphuric acid solution or electrolyte will become weaker. The color of the plates change during the chemical action. At full charge the postive plate has a dark brown coating, the negative plate having a spongy condition of dark slate color. When discharged the positive plates have a chocolate color, and the negative plates a light slate color.

(To be continued.)



OZONATOR.

The Ozonator.

A recent development of the General Electric Company, is an apparatus for generating ozone in moderate quantities by means of a high pressure or high voltage discharge of electric current through air. It represents the concrete result of investigations and experiments extending over a period of years, and its purpose is to deodorize and sterilize indoor air. Ozone diffused throughout a room quickly purifies the air. Ozonators consume a very small amount of air and the cost of operation is trifling. The value of these machines for promoting health is readily apparent and they are rapidly coming into general use in places of public assemblage, such as railway waiting rooms.

Although ozone, its properties and useful application have been known and studied by scientific authorities for many years, probably a large percentage of the public is not acquainted with its valuable characteristics and practical use. In 1785, von Marum observed that oxygen or air through which an electric discharge had taken place was possessed of a peculiar odor. He referred to this as the "smell of electricity." The same "smell" is distinctly noticeable if one happens to be in the vicinity of a bolt of lightning during a thunder storm. It is caused by some of the oxygen in the air being changed into ozone, which produces the particularly fresh and wholesome smell of the atmosphere after an electrical storm. The action of ozone in the air oxidizes or burns up floating bacteria or microscopic impurities and in moderate quantities has no harmful effect on animal life. It is Nature's own method of purifying air.

The ozonator contains a step-up transformer, to raise the voltage from that available, probably at 110 to 220v, to a high voltage, and the ozonizer proper consists of a bank of ozone generating units. Each unit consists of a cylindrical glass tube, copper plated on a portion of its outer surface, and within which is an electrode made up of shallow perforated enameled cups of such diameter as to allow a small air gap between them and the bore of the glass tube. When the high voltage is connected one side to the copper plating and the other to the electrode a violet electrical discharge takes place between the inside of the glass and the small cups and ozone is formed. The use of the ozonator in railway waiting rooms will secure healthier atmosphere and result in favorable comments from its patrons.

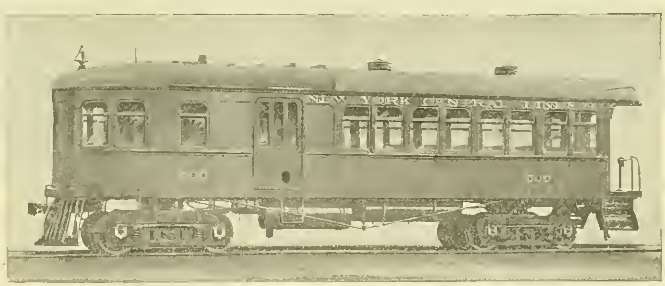
Gas-Electric Train for Pittsburg & Lake Erie.

The Pittsburg and Lake Erie Railroad is about to introduce a significant innovation in connection with local passenger service in the vicinity of Pittsburg. A contract has been awarded the General Electric Company for a gas-electric car and trailer to form a single train, which will be tried out on regular accommodation schedules. The purpose for testing the new system of local transportation on this road is to supplement the steam train service in a more efficient and economical manner, that will afford better rapid interurban transit, with more frequent and convenient stops, and a cleaner and more pleasant means of travel.

This application of the gas-electric car is unique because it represents the first instance where a self-propelled car of the gas-electric type will be employed in this country on a main line heavy four-track road for local runs and interpolated in between the schedules of limited trains. This initial movement is significant of the tendency toward quicker service on local sections of roads in the vicinity of Pittsburg, and may mark the beginning of the adoption of gas-electric cars for such service on other lines. With the greater density of traffic which is bound to result, it is not too sanguine also to predict that the step may ultimately lead to the electrification of local sections of railroad systems entering the city.

The gas-electric car for this road is designed for operation with a trailer. It is of all steel construction, except the interior finish, has the same motive power equipment and in point of construction conforms in other respects to the types of 70-foot cars built by the same company. This latter type of car was described fully on page 256 of our July issue and the method of operation as well as the mechanical and electrical construction was explained in detail. The P. & L. E. R. R. car is 42½ feet long, 10 feet 5 inches wide, weighs 36 tons and has a seating capacity for 42 people. The car is partioned into three compartments: one 20 feet 5 inches long for passengers, which has seats finished in genuine Spanish leather and is designed for a smoking compartment; a small section for baggage 6 feet long, as the traffic requirements in this case do not call for the transportation of bulky express, and a cab 12 feet long containing the power apparatus. The trailer is 45 feet long, weighs 22 tons and seats 80 people.

The gas-electric type of car affords a flexibility of operation through the application of electric transmission from the internal combustion or gasoline engine to the driving wheels that could not be secured otherwise. Smooth and rapid acceleration is obtained by varying the strength of the generator field, without losses in a resistance or due to gear changes. In this P. & L. E. R. R. gas-electric car, the two GE-205, 600 volt motors of 100 h. p. each, which are of the commutating or interpole type, are also governed by shunt field control. That is, it is possbile to cut out or shunt part of the main field resulting in increased speed.



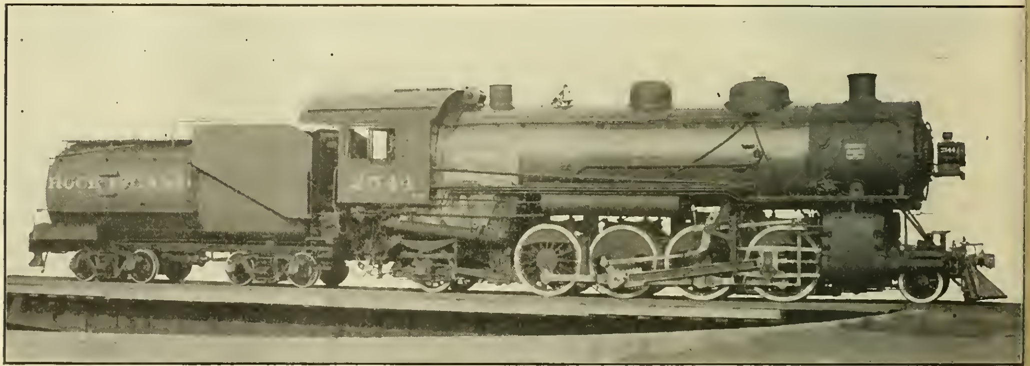
GAS ELECTRIC CAR FOR THE PITTSBURG & LAKE ERIE.

The resulting higher armature speed, due to the shunting of the fields, permits the use of a smaller pinion, and full utilization of the power input is secured throughout the entire speed range, from start to full speed.

Mikado Type Locomotives for Chicago, Rock Island and Pacific

The American Locomotive Company has recently built ten locomotives of the Mikado type for the Chicago, Rock Island & Pacific Railway. These are among the heaviest type of engines of that class built, weighing in working order 320,000 lbs., engine and tender weighing 483,900 lbs. The boiler, as shown in the accompanying illustration is of the straight top type and measures 86 ins. in diameter at the front end. Its working pressure is 180 lbs.

The reports from the railway officials in regard to the performances of these locomotives are of more than usual interest. It is claimed that they are hauling 45 per cent. heavier trains than the Consolidations which they replaced, while the amount of fuel consumed is about the same. This is a strong endorsement of the Mikado type of locomotive and it is not to be wondered at that this type is coming rapidly into favor. With large fireboxes and extensive heating surface, and superheating equipment, it has been found possible to receive a greater hauling capacity with this type of locomotive than with other types of even a higher boiler pressure.



MIKADO TYPE OF LOCOMOTIVES FOR THE CHICAGO, ROCK ISLAND & PACIFIC RAILWAY.
T. Rumney, 2d V. P. in Charge of Mechanical Department. American Locomotive Company, Builders.

The following are the principal dimensions of this type of locomotive:

Track—Guage, 4 ft. 8½ ins.; fuel, Bituminous coal.

Cylinder—Type, simple piston, diameter, 28 ins.; stroke, 30 ins.

Tractive Power—Simple compound, 57,000 lbs.; factor of adhesion, simple compound, 4.17.

Wheel Base—Driving, 17 ft.; rigid, 17 ft.; total, 35 ft. 2 ins.; wheel base, total, engine and tender, 55 ft. 11½ ins.

Weight—In working order, 320,000 lbs.; on drivers, 238,000 lbs.; on trailers, 52,500 lbs.; on engine truck, 29,500 lbs.; engine and tender, 483,900 lbs.

Boiler—Type, straight top; O. D. first ring, 86 ins.; working pressure, 180 lbs.

Firebox—Type, wide; length, 108 ins.; width, 84 ins.; thickness of crown, ⅜ in.; tube, ⅝ in.; sides, ⅜ in.; back, ⅜ in.; water space, front, 6 ins.; sides, 6 ins.; back, 6 ins.; depth (top of grate to center of lowest tube), 24½ ins.

Crown Staying—Radial stays.

Tubes—Material, charcoal iron, No. 234; diameter, 2¼ ins.

Flues—Material, seamless steel, No. 36; diameter, 5½ ins.; thickness tubes, No. 10 B. W. G.; flues, No. 9 B. W. G.; tube, length, 21 ft.; spacing, 3⅛ ins.

Heating Surface—Tubes and flues, 3,963 sq. ft.; firebox, 226 sq. ft.; arch tubes, 26 sq. ft.; total, 4,215 sq. ft.; superheating surface, 861 sq. ft.

Grate Area—63 sq. ft.

Wheels—Driving, diameter outside tire, 63 ins.; center diameter, 56 ins.; driving material, main and others, cast steel; engine truck, diameter, 33 ins.; kind, cast iron centers; trailing truck, diameter, 42 ins.; kind, cast steel centers; tender truck, diameter, 33 ins; kind, Davis cast steel centers.

Axles—Driving journals, main, 11½ ins. x 13 ins.; others, 11 ins. x 13 ins.; engine truck journals, 6½ ins. x 12 ins.; trailing truck journals, 9 ins. x 14 ins.; tender truck journals, 6 ins. x 11 ins.

Boxes—Driving, main and others, cast steel.

Brake—Driver, West. E. T. 6, Amer. W. N. 3; tender, West. E. T. 6; pump, 8½ c.c.; reservoir, 1-22½ ins. x 90 ins., 1-22½ ins. x 120 ins.

Engine Truck—Two-wheel center bearing; trailing, Cole, latest type, with outside journals.

Exhaust Pipe—Single; nozzles, 5¾ ins., 5⅞ ins., 6 ins.

Grate—Style, rocking.

Piston Rod—Diameter, 4½ ins.; piston packing, Gun iron rings.

Smokestack—Diameter, 19 ins.; top above rail, 15 ft. 8 ins.

Tender—Frame, Vanderbilt.

Tank—Style, Vanderbilt; capacity, 9,000 gals.; fuel, 16 tons.

Valves—Type, piston; travel, 7 ins.; steam lap, 1 3/32 ins.; ex. lap, G. L. line and line.

Setting—⅛ lead.

Passes Rigidly Prohibited.

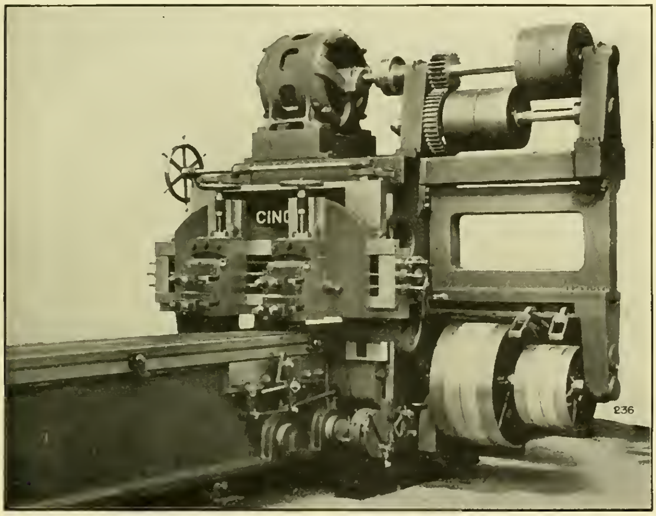
The Interstate Commerce Commission is displaying extraordinary energy in trying to ascertain how closely railroad companies are obeying the law prohibiting the issue of free transportation. Its inspectors are examining the pass giving records of railroads as rigidly as if every railroad company under its supervision was guilty of habitual fraud. It is wonderful how much annoyance can be inflicted by a body vested with a little brief authority. The Interstate Commerce Commission inspectors are said to be particularly fierce in prohibiting railroads from giving free transportation to superannuated employees. We heard of a case where a railroad company had granted an annual pass to an old superannuated engineer and the demand was made that this terrible violation of the law be at once withdrawn.

Resisting Gravitation.

The *Scientific American* has been investigating the validity of the common flea and makes out a very strong case against the pest. Science mathematicians have figured out that if a man possessed jumping vitality equal to that of the flea he could leap over the Singer Building, New York, 400 feet high. Preserve us from such overbearing ambition, and let us rest and be thankful.

New Frog and Switch Planer.

Among the recent new machines placed upon the market by the Cincinnati Planer Company we note a 36-in. Frog and Switch Planer. In addition to the very substantial construction of the machine, it will be noted in the accompanying illustration that there are several new features worthy of particular attention. Among these are the four belt drive, that is, the machine is driven by two 4-inch belts. The driving pulleys are 34 in. in diameter, and are made from aluminum alloy, giving a very quick reverse on short strokes. The Vees of the bed are furnished with forced lubrication by a positive feed pump, which insures a continuous film of oil between the bed and the moving parts at all times. The countershaft is mounted on top of the housings, making the machine completely self-contained. A heavy cast frame is fitted between the upper and lower bearings and is also attached to the housings, entirely precluding the possibility of spring to the shafts or bearings under the heaviest cut. A fifty horse motor is attached to the upper casting and is out of the way of the operator.



FROG AND SWITCH PLANER.

The construction throughout is of the most rigid kind, the driving shafts being unusually large in diameter, and are made from special crucible steel, accurately ground, and run in long bearings fitted solidly into the bed. The machine is in every way admirably adapted to withstand the enormous strains incident to the heaviest kind of Frog and Switch work.

The Locomotive in Europe.

The steam locomotive continues to be the most fascinating of all the varied studies presented by engineering, says the London *Times*. Now and again its preeminence may for a moment be threatened either by the brilliant performance of a rival means of propulsion or by the predictions of a theorist, but notwithstanding all that is said and done and written, it continues to reign supreme in its own sphere of usefulness. In seeking for a reason for its persistence, it is realized that the locomotive has a remarkable power of adapting itself to the requirements of the designer, and that it has potentialities that constitute a wealth of reserve force.

Within recent years it has been called upon to increase its power alike for passenger and goods service, and this demand has been met partly by the introduction of higher boiler pressures, and partly by increase of the dimensions of cylinders. Loads, speeds, and lengths of run have become more exacting, and the costs departments have simultaneously directed their efforts toward economies.

To meet these requirements, the mechanical engineers of railway companies have been led to invesitgate the merits of such devices as depend upon the use of oil fuel, compounding, and the adoption of superheating of steam, and it is to be observed that the progressive movement is now in evidence among even the most conservative users and designers.

In the matter of superheating, Great Britain is generally regarded as being behind the Continent, and in any case it must be acknowledged that German and Belgian engineers have done praiseworthy work in developing the superheater into a satisfactory appliance for locomotives. At the same time it is fair to state that in this country (England) a considerable amount of steady experiment work has been in progress for some time, and that the great accession of superheaters to British locomotives is the result of careful scrutiny of a complex question of ways and means.

When the proposal to use superheaters for this purpose was first put into practical shape there were great difficulties to be overcome, and it was not desirable to adopt such devices in their original forms. Their use was, in fact, attended by a certain degree of risk, and their economy in working was problematical.

Today the designer is able to record a complete victory, with consequent increase in power, lower cylinder pressures, and greater flexibility to meet the heavy demands that fall upon the most willing of all propelling agents, with the result that the steam locomotive has been given yet another lease of life.

New Method of Galvanizing Iron.

In order to protect iron objects from rust, it is customary to coat them with zinc either electrolytically or by plunging them in a bath of melted zinc after careful cleansing. The disadvantage of these methods is that a real fusion of the two metals is not obtained. As a result the zinc coating is likely to be attacked by the atmosphere.

This may be avoided by a recently patented process which consists in so preparing the iron that the zinc gets into its pores. After steeping in sulphuric acid the iron is placed in a solution of mercury chloride and then heated, resulting in decomposition of the mercury chloride and precipitation of metallic mercury, which forms an amalgam with the iron on the surface. The iron is then plunged into a zinc bath heated to 500 degs., where it remains three minutes.

Iron galvanized by this process shows unusually strong adhesion of coating to metal. Microscopic investigation shows that the zinc penetrates into the pores of the iron, and in case a portion of the coating is worn or broken off, iron does not rust owing to the presence of sufficient zinc in the pores.

Shorthand.

The number of people who have studied the Pitman system of shorthand must be immense. According to the *Evening Sun* preparations are being made for the centenary of the birth of Sir Isaac Pitman, which occurs in January next and is to be celebrated in London, Manchester and New York. Dr. Woodrow Wilson, Mr. Carnegie and the Lord Mayor of London are on the centenary committee, which is enlisting adequate support for the commemoration of the inventor of the most widely used system of shorthand in existence.

The Evolution of Transportation

By W. N. MITCHELL.

PART II.

The first man to build a locomotive to run on rails and haul cars, was William Hedley, chief engineer of a colliery on the River Tyne. His first engine, however, was not a success, but the experience gained through the knowledge of its shortcomings enabled him to build a second one which worked fairly well. This was known as the "Puffing Billy" and may still be seen in the South Kensington Museum, London.

Early in the 19th century (1804) Richard Trevithick, a Cornish mining engineer, built several steam carriages for common roads and one engine to run on rails, but they were all failures from a commercial standpoint, although they possessed the elements that would have produced a successful locomotive in the hands of a persistent inventor.

When the Liverpool & Manchester Railway offered a prize for a locomotive that would meet certain requirements, the fact that George Stephenson's "Rocket" won in competition with several others, has given to Stephenson the reputation of being the inventor of the locomotive. It is unfortunate that this credit has been misplaced, for Stephenson had many predecessors who had practically solved every obstacle connected with steam locomotion except its commercial application.

Locomotives produced by other early inventors obtained more or less distinction. Probably the most diminutive of these was one built by Peter Cooper and named "The Tom Thumb." It weighed a little less than a ton, and its boiler flues were improvised from gun barrels; nevertheless it drew 4½ tons over curves and grades of the Baltimore & Ohio railroad at a speed of over 12 miles an hour.

It is impossible to crowd into the limited time at our disposal a recital of the rapid development of the steam engine and the extension of its use to various forms of transportation.

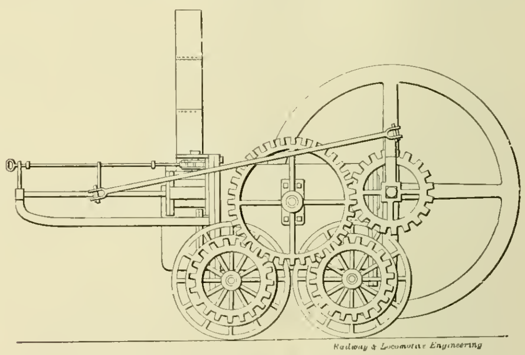
From 1602, in which year, as already mentioned, the first railways were constructed, until the Stockton & Darlington Railway was opened (1825), no really successful locomotive from a practical standpoint had been evolved. The stages of evolution through which the steam engine passed before being combined with some form of a vehicle so that it would furnish the power to transport its own weight, as well as tractive power for a train, were many. Trevithick and many other mechanics and inventors were trying to redesign the steam engine so it could be used to furnish the motive power for the tram cars hauled on the tramways of the day, but complete success in this field of endeavor was not achieved until George Stephenson's inventive genius had worked out the commercial solution of this application.

However clever we may regard the products of early inventors engaged in developing the locomotives, we must, nevertheless, in our day regard their products as freaks or curiosities. A few illustrations made from old prints will show some of the early successful locomotives that were operated during the early and middle years of the last century. They will also serve to show how many experiments had to be made to evolve the present locomotive. A mere visual comparison of these early engines with one or two present-day types will reveal at the then terrific speeds of from 6 to 12 in all its glory the modern locomotive. Early locomotives which thundered along miles per hour, are far from the modern class of locomotives which annihilate space at speeds of considerably over one hundred miles an hour over long stretches.

The Stockson & Darlington Railway was opened on September 27, 1825, and on that day the engine known as locomotive No. 1, driven by George Stephenson himself, hauled what was certainly a historical train. With the exception of a coach in which rode the directors and owners of the road, the train consisted of cars loaded with coal and flour.

It would take a long time to recount the opposition which this transportation enterprise had to encounter before being crowned with success through public recognition and approved. No one seemed to be able to see the great use, the absolute necessity, in fact, which this development in transportation facilities was to be to the world; but the results of the opening of the Stockton & Darlington line were surprising. The original scheme had not contemplated the carrying of passengers; yet on the first day many hundreds of persons rode from Darlington to Stockton and back, and these persons soon insisted upon regularly making this trip. The success attending the opening of the road and the novel facilities for traveling induced the company to put on a passenger coach as an experiment, and the innovation was such a success that additional coaches were promptly provided, resulting in passenger service becoming a very important part of the road's business. In the modern sense of the term, therefore, railway transportation began with the Stockton & Darlington Railway.

The success of the Stockton & Darlington enterprise resulted in a declaration signed by 150 leading men of Liverpool, setting forth that new means of transportation were indispensable between that city and Manchester, and it was not long before measures were adopted which eventually led to the construction of a railroad between those towns. To follow step by step the extension of steam-operated railways in England, is not necessary.



TREVITHICK'S LOCOMOTIVE, 1808.
First Locomotive Built to Run on Rails.

It is noteworthy to record the fact that the evolution of the locomotive was more rapid than the evolution of the track upon which it had to run, and for many years this caused limitations to be placed on further advance in locomotive design because no track existed that was sufficiently durable to carry heavier engines, at the speed possible to secure from them if run to the limit. But the increased speed and safety resulting from guiding vehicles on rails, suggested all sorts of possibilities and naturally awakened inventive genius.

It took many years to evolve the now universally common "T" rail and the present forms of roadbed. It likewise took many years to evolve the present forms of rail fastenings. Even now satisfactory in their way as they are compared with the devices of the

past, continued and concentrated study must be applied to the development of all forms of track equipment, to make them satisfactory under the rapidly increasing service to which they are subjected, as a result of the very advanced development of present-day rolling stock.

Another interesting evolution which of necessity was brought about was the evolution of the early railway carriage through the various stages leading up to the palatial modern passenger coach. To us who ride without thought or care in the magnificently appointed Pullmans, where every convenience of home and office is at hand, it seems incredible that in the early days of railroading any one could have been elated, as was really the case, to ride in the carriages of those days. Most of these were nothing more than the ordinary forms of road coaches, of which the historical Concord coach is an example, placed on the grooved wooden stringers and hauled by the tractive power of the crude early locomotives. The modern conveniences of steam heating, electric lighting, and others of like nature, without which we would regard modern travel unendurable, had perhaps been only fantastically dreamed of, yet some of these fantastic dreams, if such they may be called, were really prophetic.

We have spoken of Mr. Gurney's steam-carriage. The lack of seriousness with which steam as a tractive motive power was regarded, may be learned from reading the following copy of a hand bill which was issued in ridicule of Mr. Gurney's modest attempt:

THE PATENT
STEAM
C O A C H.
called the
Pyrohydrometer
Carrying
60 PASSENGERS
And 40 Tons
of Luggage,
and travelling at the rate of
A MILE A MINUTE,
will start from the
HOT BATH PUMP ROOM,
every Monday, Wednesday and Friday
Mornings,
at 8 o'clock,

Overland to MOSCOW, from whence it will proceed to CHINA (calling in its Journey at ETNA and VESUVIUS for a Supply of Fuel) and return on the alternate Days.

This Coach possesses Advantages not to be met with in any other Conveyance, viz., it supplies abundant Light and Heat in the darkest Seasons and coldest Climates; and in the Torrid Zone it affords a refreshing coolness by watering the Roads and laying the Dust by the Waste Water from the Boiler. Passengers may also cook their own Dinners, or provide Tea and Coffee whilst upon their Journey.

Performed by the Public's most warmly devoted Servants,

FIRE, FAGOT, and FURY.

In this we see present-day speeds prophesied, though the prophesy falls far short of present-day realizations. There is the Pullman, electric-lighted and steam-heated; the dining car equipped with everything that an epicure could wish; the baggage car taking the baggage of the train's patrons to destination with them. Jules Verne's fiction of "Around the World in Eighty Days" has been eclipsed. "Twenty Thousand Leagues Under the Sea" is typified in the modern submarine boat.

The first railways in America were tramways similar to those of England, and were constructed for like purposes They did not contemplate passenger-carrying facilities and were built to accommodate the needs of collieries or stone quarries; but it was not long after the successful application of steam locomotion on the English railways, before steam railways were built in the United States.

The Baltimore & Ohio railroad claims the distinction of being the pioneer public carrier in America, and as for other early roads in this country, horses furnished the tractive power. The Mohawk & Hudson, from which humble origin the New York Central & Hudson River has grown, is said to have been the second railway enterprise in America. Then came the Philadelphia & Columbia Railroad, built with the intention of eventually connecting Pittsburg and Philadelphia, as a result of an adverse report regarding the building of a canal to connect the two points mentioned. The present great Pennsylvania Railway system is the offspring of the Philadelphia & Columbia. In 1830 the Camden & Amboy railroad was planned, and from then on, the development of railroad enterprise in various sections of the country was rapid.

The first locomotive used on American railways were of English manufacture, and the first locomotive to be used on any American railroad was known as the "Stourbridge Lion." The first steam locomotive built in America was constructed in Baltimore and made its first trip over the Baltimore & Ohio railroad. This engine was the product of Peter Cooper. When we consider that it weighed less than a ton, the name of "Tom Thumb" seems to fittingly describe it. The boiler flues were nothing but gun barrels and the engine developed only about one horse power; nevertheless, it succeeded in drawing 4½ tons over grades and curves at a speed of over 12 miles an hour. It made the first trip from Baltimore to Ellicott Mills in an hour and a quarter, and the return trip in 57 minutes.

Notwithstanding early obstacles surrounding the development of steam transportation in the ten years from 1830 to 1840, the total railroad mileage of this country had at the later date reached 2,818 miles. The obstacles that played the most important part in preventing greater extension of railways, were due to the fact that track and roadbed, track fittings and changes in types of car wheels, alternately failed to keep pace with one another.

The Stockton & Darlington Railway was laid with rails of cast iron, joined four feet, and it can well be imagined that the traveler, in passing over this road, was subjected to frequent jerks and jolts quite audible and sensible through the numerous joint connections and consequent impossibility of preserving surface to track.

The track of the Baltimore & Ohio consisted of cedar cross-pieces and stringers of yellow pine, 12 to 24 feet long and 6 inches square. These strips had iron bars attached to them and the flanges of the car wheels were on the outside instead of inside, as now. After miles of this kind of road had been constructed, long granite slabs were substituted for the cedar cross-pieces, but in 1832 wrought-iron rails had been laid on part of the line. Many years passed before any other type than flat rails were made in America. All other types that were used in this country were imported from England, and it was 1843 before there were facilities for manufacturing types of heavy iron rails in the United States.

It would be hard to say how many experiments were made before anything approaching the present standard rail section was devised. How little was known in the early days as to the desirable requirements for rails, may be illustrated by a single incident. Considerable anxiety was felt as to the possible effect that frosty weather might produce on rails by glazing them with ice and thus prevent the necessary frictional adhesion between them and the wheels. To offset this possible contingency, it was quite seriously proposed to make rails hollow, and during frosty ter. Even now the weight and form of weather keep them filled with hot wa- rails employed on railroads are subjects of increasing interest.

The safety of modern travel compared to the safety in the early days is beyond fair comparison. No such devices as brakes were on engine or cars, no such devices as communicating signals led any part of the train to

the engineer, no block nor interlocking signals were along the roadway, none of the modern devices now so essential to safe railroading, had perhaps been more than thought of. They became needs only as the evolution of railroading progressed.

Although it was of the utmost importance to the public and every one connected with the operation of a locomotive, that the boiler pressure be maintained below a certain tension, serious defects were common in the construction of safety valves, and as might be expected, this resulted in much too frequent and disastrous boiler explosions. As an incident of early railroading, it might be mentioned that one of the pioneer railroad companies made explicit mention in its advertising of the fact that it hauled a car immediately following the engine, loaded with cotton bales, to prevent passengers from being injured when the boiler exploded. Such sources of danger have been eliminated and modern safety valves are depended upon to prevent the steam pressure from rising more than two or three pounds above the blowing-off point intended.

A great part of the increased efficiency of boilers is due to the highly perfected appliances now used for feeding the water to them. Injectors that can be regulated to supply the exact volume of feed water required, have put out of service the unreliable force pump and thereby safeguarded the boiler by limiting more closely the extremes of temperature to which it was formerly subjected. Steel boiler tubes have taken the place of copper, brass and iron tubes, and most of the old boiler troubles have thereby been eliminated.

In the pioneer days, very little attention was given to the necessity of lubricating valves and cylinders, and a light charge of tallow was considered sufficient, although this practice resulted in considerable loss of power through excessive friction. The latest appliances for lubricating valves and pistons are now so effective that a constant and regular supply of lubricant is now fed to the points needed.

For many years railway mechanics worked with the object in view of making the locomotive as simple as possible, and the working parts were so arranged that repair expenses would be kept at the lowest point. The fragile tramways over which the early locomotives were operated, necessitated provisions to reduce as far as possible the shocks from the movement of the power-producing machinery and running gear. Driving wheels of engines were counterbalanced, and reciprocating parts received the greatest possible attention in design. Equalizing beams were introduced at an early date to evenly distribute among the wheels the shocks caused by passing over low joints or other defects of track. Steel-tired wheels, almost immune from breakage, gradually took the place of cast iron and wrought iron.

The development of the air brake not only represents the result of the remarkable progress of railroad operation during the last quarter of the nineteenth century, but has in a great degree contributed to the character of the development of railroad practice in general. The air brake did not reach its present efficient form by a sudden leap. Its evolution has been slow and has been brought about by rapidly changing conditions in transportation as evinced in railways.

The original conception of the air brake was due to the genius of George Westinghouse, and practically every development in air brake practice since 1869, when Westinghouse introduced the straight airbrake, can be laid to the door of this man. The air brake has been evolved through stages which may be marked by four different forms; namely, the straight air brake, the automatic air brake, the quick-action automatic air brake, and the high-speed air brake. Each efficiently fulfilled the requirements of its day and formed the model for each successive step of development. It seems almost incredible that the heavy trains running at the speeds common today, may be so gently and easily brought to a standstill within such limited distances as is possible through the control afforded by the modern air brake, and yet there is no doubt that the efficiency of the air brake of today is far from what it will be a few years hence.

Signaling methods on railways were first introduced in England on the London & Northwestern Railway, in 1859, and were in the form of interlocking plants. In 1873 interlocking devices had become remarkably general on the English railways, while at the same date there was not a single interlocking plant in operation in the United States. In the following year, however, the first interlocking plant in the United States was put in operation, and while it may be true that at the present time the proportion of mileage equipped with modern signal systems in this country as compared with the proportion of mileage so equipped in England is against us, nevertheless it is undoubtedly true that the most efficient block and interlocking signal systems in the world are in use on American railways. If the human element, which always enters into affairs directed and guided by humans, could be eliminated, our signal systems would be infallible, and such accidents as collisions would be a thing of the past.

Instead of the old link and link pin, rolling stock is now equipped with automatic coupling devices. Before such devices were in general use, the loss of life and limb that was the toll of coupling cars by the old methods, was enormous. For instance during the year 1891 there were 415 men killed and 9,431 injured coupling cars. Every step onward in the evolution of the railway has been one which increased the factor of safety, at the same time that other, though less important, achievements were realized.

Those spots along the early railroads which were dignified by the name of "station," had nothing about them suggestive of the modern railway station. To record development of terminals and terminal facilities made necessary by the wonderful increase of travel, all the result of the evolution of transportation, would require the space of volumes.

The development of the locomotive in America has kept pace with other railroad development. The use of steel rails and huge locomotives has exerted wonderfully far-reaching effects. It has created social revolution. The grains of the northwest are transported to markets hundreds of miles from where grown. The fruits and vegetables from California flood the markets of New York. Unlike transportation development in Europe and elsewhere, the railroads in this country, instead of following the settler and civilization, have preceded them and blazed new trails for each to follow.

In less than three-quarters of a century, what once was a vast wilderness on the American continent, has been changed from untrodden forest, dismal swamps, and pathless prairies, into the abode of the most advanced of modern civilization. It is very doubtful whether, considered historically or otherwise, the mind of man has ever brought forth anything which has contributed more to advance civilization than the locomotive. It has brought outlying and previously inaccessible points within reach; brought separated and isolated sections into closer connection with each other.

Lord Bacon said, "There are three things that make a nation great and prosperous: A fertile soil, busy workshops, and easy conveyance of men and animals from place to place;" and from times immemorial, the most highly developed communities have been those in touch with, and served by, the best systems of transportation of their day and age. It is true in these days, for the most progressive, most highly developed and commercially important centers of the world are those enjoying the best transportation facilities.

Opening of the Brady Brass Company's New Foundry.

The Brady Brass Company, Jersey City, opened their new works, 170-182 Fourteenth street, Jersey City, on the 3rd of last month. The occasion was made memorable by the presence of a large assemblage of interested spectators, among whom were several hundred leading railway men. The interior of the main building, which measures 175 feet by 100 feet, and with annexes extends from Fourteenth to Fifteenth streets, was finely decorated, and a sumptuous repast was served, after which Mr. Brady, who planned the establishment, and his colleagues, explained the details of the entire plant, which is a model of its kind. The buildings are of reinforced concrete and heavy mill construction. The foundry has a capacity of thirty tons per day, the chief products being journal bearings, engine castings, white metals, motor bearings and battery zincs, in addition to which are babbitt metals, phosphor bronze, cyprus bronze, cyprus anti-friction metal, and other alloys to any specification. The patterns on hand ready for use number 12,000, and include every variety of bearing or part used in light or heavy machinery, especially in railroad mechanical appliances.

The erection of the new works had become a physical necessity, as the increasing volume of business had literally outgrown the company's works in Tenth street, the present year being the most prosperous in the company's experience. The furnaces are of the natural draft, coke fire crucible type which experience has shown to be the best calculated to produce castings free from defects. The moulding machine has a capacity of 1,200 bearings per day, and the boring mills, of which there are four of the Bement type, possess great accuracy with high speed. The machine shop equipment includes ten lathes with milling, shaping, drilling, grinding and polishing machines, together with a complete outfit of micrometer gauges, and, in brief, every kind of tool necessary for turning out motor or journal bearings from one to fifteen inches in diameter.

Probably the most notable feature of the new plant, apart from the admirable plan and fine arrangement of details, is the overhead trolley system, which reaches every section of the entire foundry, and conveys with ease and rapidity all metals and materials to and from various parts of the works. The offices are also very complete, and embrace a draughting room and laboratory, the latter being fully equipped for analysis and assaying, with special reference to the rapid determination of metals and elements used in the productions of non-ferrous alloys.

In brief, the Brady Brass Company's new plant is one of the most thoroughly equipped foundries that we have ever seen. The company are to be congratulated on the result of their enterprise. Mr. Daniel M. Brady, the worthy president, has the good wishes of all who have the honor of his acquaintance. He is fortunate in having associated with him men of marked ability and thorough training. Mr. W T. Van Horn, secretary, Mr. W. Woodman, and Mr. G. M. Phillips in charge of draughting room and laboratory, are trained engineers and qualified by education and experience to master the scientific details of the work. Over one hundred workmen are employed in the foundry, and the prospects bid fair that it will soon be running to the limits of its capacity. Our illustration of the company's new works, although taken before the building was quite completed, will give some idea of the exterior appearance of the main building.

THE BRADY BRASS COMPANY'S NEW WORKS, JERSEY CITY, N. J.

The Neville Automatic Boiler Alarm.

The Neville Automatic Boiler Alarm, which was illustrated in our September number, has passed into the control of the Nathan Manufacturing Co., New York, who may be depended upon to push that valuable invention into the popular standing its merit deserves. The Boiler Alarm has already been applied to many locomotives belonging to the Harriman Lines with the most gratifying results, no fire box accident having happened to any of the engines so equipped. When a boiler explosion happens to a locomotive, it is already beginning to be the opinion of railroad men that the Neville alarm would have prevented the accident. We have seldom met with any invention that excites so much confidence among enginemen as this one does.

We understand that the Salt Lake Lines have made a contract to equip all their locomotives with the alarm and that the Michigan Central and the Colorado Southern are experimenting with it.

Chinaman's Application for a Job.

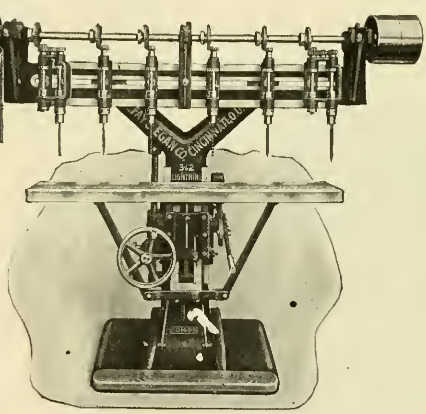
When Julius Kruttschnitt was general manager of the Southern Pacific, his kindly manner appealed very strongly to the Chinese and one day he received the following application for a position:

"Dear Sir.—I have a great pleasure to inform you that, having understood from my bosom friend T. Wong that, there has a position of writer which is vacant at your magnificent office during you are amplifying the traffic of your establishment. Inasmuch, I reflect this occasion is prefectly habitual upon my knowledge. So I hasten with liberty to write these few lines to you about this valuable opportunity. Since I was going as assistant interpreter and accountant of Toatai Lin for a period about three years. As the commercial duty and office work do not seem to be difficult on hand, and my literature of English had been possessed six years in experience. If it be suit you or not and hope you will have many benevolences to answer me as soon as you receive my this application with immense solicitation. If I shall be beholden by your kindness the salary should be moderate as you please. The epoch of my ages is twenty-two and native is Kwongtung province. Trusting you will not reject my proposals. With kind regards. Your obedient servant—F. N. Lok."

The use of liquid fuel for locomotive purposes is spreading rapidly all over the world, American furnace appliances being universally used. The latest railway to experiment with oil fuel for its locomotives is the Meklong Railway of Siam. Petroleum wells have been discovered in Siam and the product will doubtless be used for industrial purposes.

A New Multiple Boring Machine.

While Multiple Borers are not something entirely new, their use has been limited because their admitted advantages were in most cases outweighed by many disadvantages in adjustments. In the new No. 312 "Lightning" Multiple Borer recently brought out by J. A. Fay & Egan Company all the disadvantages of the older types have been overcome. In the first place, all adjustments are made from the front of the machine. The spindles are easily and quickly set for boring at any point, in line, or staggered up to the width of the frame. The spindles are furnished single or in practically unlimited variety of radial and cluster arrangements for special work. Troublesome belting, hot journals, noise and other annoyances incident in the old style machines are eliminated entirely as the spindles are all driven through bronze and steel gears, cut from the solid, and each spindle has ball bearing end thrust. The bearings are of phosphor bronze with continuous oil flow and are so simple that they can be taken apart or put together with no tools other than a spanner wrench and screw driver.



NEW MULTIPLE BORING MACHINE.

Here, then, is a machine which will bore as many as twenty holes either in a line so staggered, in the time required to mark and bore one hole, that will make each piece an exact duplicate of the others, and that is so arranged that it can be quickly and easily set for all kinds of work. As a cost reducing proposition, this tool should appeal to all manufacturers and further information may be obtained upon application to J. A. Fay & Egan Company, 445 W. Front street, Cincinnati, Ohio.

The Northern Pacific has ordered 50 Mikado locomotives and 10 Mallet locomoties from the American Locomotive Company.

Wrecked a Train for Revenge on Engineer.

If a story told by New Central Railroad detectives is true, a disastrous wreck to what was known as the Thousand Islands Express on August 6 last, was an act of revenge conceived and carried out by a man named William Cassidy in revenge for a grudge conceived against Michael Stump the engineer of the train derailed. The detectives say that he turned a switch in the station yards at Camden, causing a terrible disaster to the train. It seems the detectives have been fraternizing with Cassidy for several months, by which means they learned that he got keys made to fit switch locks and that one of them aided in his diabolic purpose. As usual there is talk that Cassidy is insane, but it is the species of insanity which ought to lead such reptiles to the electric chair, or at least be placed where he would be out of harm's way.

High Speed Caused Hyde Park Wreck.

The New York Public Service Commissioners have made a very thorough investigation into the cause of the derailment of the New York Central's Twentieth Century Limited at Hyde Park last March when seventy-three passengers and employees were injured. In the report covering many pages the Commission declares that the freezing and thawing makes uneven tracks and that the difficulty of inspection and repairing is greatly increased. Instead of the elastic roadbed of summer, the structure becomes almost as solid as a rock, and the strain on the rails, on locomotive tires and on car wheels and axles is greatly augmented, often to the breaking point.

The accident under discussion, in which seventy-three passengers and employees were injured, was due to an irregularity in the track caused by freezing and thawing, says the report, and not a broken rail, as was generally supposed at the time.

Touching on the reduction of speed the report says:

"The important element to consider in connection with the study of this question is the necessity of continuous high speeds imposed by the maintenance of fast long distance schedules during the winter. The record of accidents to fast trains during the last year raises the question whether the schedules are not too fast for safety. It appears to be evident that, whatever the factor of safety may be in summer, it must be materially reduced under winter conditions.

"In view of this accident the commission has felt it desirable to suggest a reduction of speed during the winter of some of the long distance runs, notably the Twentieth Century Limited. The subject has been discussed with the principal operating officers of the New York Central and Pennsylvania.

The proposal to lengthen the schedule of these trains in winter has been favorably received by the officers of both companies, and a wish to reach an agreement on the subject has been indicated. As a result, we expect that the schedule of the Twentieth Century Limited trains between New York and Chicago will be lengthened from eighteen to twenty hours next winter."

The commission, in its long investigation of the cause of the Hyde Park accident to the New York Central's Chicago train while running at high speed along the Hudson finds it was an irregularity in super-elevation of the outer rail, or what is more commonly known as a low spot in the track.

Glad Tidings.

With all sorts of food soaring in price to an altitude that few poor people can follow, it will be glad tidings for many of our householders to learn that a Russian chemist proposes making eggs out of air. Most of our readers are aware that of late years chemists have devoted much attention to synthesis or the building up of substances, such as rubber from the elements used by nature in producing them. This Russian chemist evidently has compassion on the hungry whose plaints are heard in many lands, and he has determined to make the generation of artificial eggs his first great work. There is no scarcity of raw material for the atmosphere is rich in the elements that make nitrogenous foods.

We should not be surprised if the day should came when every kitchen boss will have a machine through which eggs and other edibles will be turned out by as small effort as is now required to convert milk, etc., into ice cream.

Just as much as we claim, the world gives us; and posterity has enough to do in nailing the base coin to the counter.

Diversities of Horse Power.

When the demands of a growing business required that James Watt, the famous engine improver, devise some method of measuring the power of steam engines, he thought of several plans, but finally decided that horse power would be the most comprehensive. Nearly everybody knew in a loose way something about the load a horse would haul, so Watt proceeded to find out with exactness the hauling capacity of the horses in his neighborhood. Experiment proved that an ordinary horse would put a strain of about 220 lbs. upon the traces of a wagon and travel at the rate of 100 ft. per minute. That was the equivalent of raising 22,000 lbs. one foot per minute, and was in its day known as the Actual Horse Power. Business was very dull in steam engine building at the time this investigation was made, so Watt and his associates, in order to stimulate business, began offering to sell engines with horse power reckoned at 33,000 lbs. raised one foot per minute. Of course, engine purchasers readily accepted this inducement, but it proved like many other cases of breaking prices much more easy to reduce than to restore. So in the course of time the standard horse power of all nations became 33,000 foot lbs.

For more than a century Watt's 33,000 foot lbs. horse power has been employed to indicate the capacity of all kinds of machines, but the progress of science and invention is beginning to prove too much for our old-familiar measure. In figuring the horse power of a steam engine the piston area, average steam pressure and number of feet moved per minute gives the horse power when divided by 33,000. That is a simple operation, but figuring the horse power of some heat engines is a much more complex problem. Our Glasgow representative, Mr. A. F. Sinclair, answering a question of a correspondent in the Glasgow *Herald* concerning the horse power of an internal combustion engine, says:

The inquirer complains that different makers with identical dimensions of cylinders state in their catalogues different horse powers, and he wishes to hear of a formula which can be applied to all engines with a certainty that the horse power shown shall be accurate. I am afraid that no such formula is in existence. It is true that by much patient calculation an approximately accurate result may, in some cases, be obtained, but it is nothing more than an approximation, and some of the factors in the calculation are not easily obtained. In a rough kind of way an estimate may be formed of the relative horse power of two makes from the cylinder dimensions, but such estimates must assume uniformity of mean pressure in the cylinders, of piston speeds, of bore and stroke ratio, as well as number of crank revolutions. Evidently to obtain such uniformity would have the effect of interfering in some cases with the most complete efficiency of the engines, and any comparison might well be entirely misleading. Let us take two four-cylinder engines, of equal dimensions, one intended to be fitted to a comfortable four-seated family car to be used chiefly in touring, the other to be used for speed. In the first engine the parts are of good size, such as will give good wear, the maximum number of revolutions per minute is 1,800, the compression is moderate, and the valves and cams are normal. The inlet and exhaust pipes are of moderate dimensions, conveniently fitted. There is no cut-out, but the silencer is both large and effective as a silencer. Only one ignition is fitted, and, in fact, nothing out of the way is attempted. In the second engine superior material is used, so that the reciprocating parts are much lighter than in the other, while the cams are high and the valves large. The engine speed may be 3,000 r. p. m., while in the matter of compression it is as high as possible, short of the spontaneous ignition point. The inlet pipes are larger than usual, and by the elimination of sharp turns they reduce the obstruction of the incoming charge to a minimum. Then the exhaust pipes go straight into the open air by the shortest road consistent with safety. In a word, everything is sacrificed to get power, and it is quite within the range of possibility for the second engine to be more than double that of the first. For instance, some of the 3-litre engines used in the Coupe de l'Auto races in France have developed as high as 60 horse power on the brake, yet their rating in this country for taxation purposes would be but 15 horse power.

The inquirer points out that many makers describe their engines as of a given "brake horse power," and he suggests that by the expression they may mean quite different quantities, that is to say, they may have different standards of assessment. While there are a variety of methods by which the brake horse power may be ascertained, that is to say, various forms of resistance may be employed, there is only one standard. The method may vary from the rough and ready drum rope and weight to a form of electrical resistance, but all are intended to show how many horse power on the basis of raising 33,000 lbs. one foot in one minute the engine is capable of developing. But it is suggested that such power must be taken by the average purchaser of a car on trust, that the methods employed are those of the testing shop or laboratory and mean nothing to the man in the street. There is a good deal of justice in such a view, but the buyer must remember that the car is usually sold on the basis of capacity to perform certain work such as propelling a motor car weighing, say, 25 cwt. at a speed of 40 miles an hour on the level in a still atmosphere. Provided the engine performs that work in a satisfactory way, it is bound to have developed sufficient horse power to comply with the specification. Nevertheless there are certain recognized formulæ by which the approximate power of different makes may be ascertained, always assuming of course that in weight of parts, cylinder design, compression and revolutions per minute the different makes are about normal. The best known is of course the R. A. C. formula used for taxation purposes. All that one can say in its favor is that it is merciful to the taxed. So far as assessment of horse power is concerned, it may be ignored. One of the best known of the recognized formulæ is to square the diameter in inches of one cylinder, multiply the square by the cube root of the stroke, and by the number of cylinders, then divide by 5. Then the Dendy Marshall formula, in which great faith has been expressed in various quarters, is to multiply the square of the bore in inches by the stroke and the number of cylinders, then divide by 12. The formula of the Society of Motor Manufacturers and Traders is more complicated whatever the result may be. The bore or cylinder diameter in inches is multiplied by the same diameter, minus 1, then by the bore and stroke ratio plus 2, again by the number of cylinders, and the product is divided by 5. The ratio is the stroke in inches divided by the bore. It would be useless to multiply those formulæ; they are only, as has been said, approximations, and may under unfavorable circumstances be misleading.

Any Change Good.

Once upon a time, remarked Dan Brady, the Joint Committee of the Master Car Builders' and Master Mechanics' Associations met in New York City. That promoter of harmony and goodfellowship, Eugene Chamberlain, felt moved to give the members of the committee a good time, so he borrowed a yacht from W. K. Vanderbilt, Jr., and took the party out on a fishing expedition. It turned out to be a stormy day, and nearly every one of the party got seasick. Donald R. MacBain was lamentably sick. Donald is a big man, and every inch of his person was suffering. Eugene went up in a sympathetic fashion, and said, "Mac, I'm afraid you're not enjoying yourself." "Enjoying myself!" exclaimed Donald. "Man, I would give ten dollars at this moment to be in your city prison."

Every employee has more to do with the amount he earns than has the employer.

Items of Personal Interest

Mr. J. A. Clough has been appointed master mechanic of the Southwestern, with office at Archer City, Tex.

Mr. C. E. Egan has been appointed general foreman of the Missouri, Kansas & Texas, with office at Waco, Tex.

Mr. W. Sapp has been appointed night roundhouse foreman of the Santa Fe, at Sweetwater, in place of Mr. J. A. Whithurst.

Mr. C. E. Langston has been appointed master mechanic of the Marshall & East Texas at Marshall, Tex., in place of Mr. F. A. Walsh.

Mr. J. A. Whithurst has been appointed general foreman of the Kansas City, Mexico & Orient, with office at San Anjelo, Tex.

Mr. E. J. Hufford has been appointed master mechanic of the Chicago Great Western at Des Moines, Iowa, in place of Mr. F. L. Carson.

Mr. A. S. Wright has been appointed locomotive foreman on the Grand Trunk Pacific at Regina, in place of Mr. A. J. Roberts, resigned.

Mr. A. Maynes has been appointed master mechanic of the Canadian Pacific, with office at London, Ont., in place of Mr. A. E. Stewart.

Mr. J. C. Shreeve has been appointed master mechanic of the Joliet division of the Elgin, Joliet & Eastern Railway, with office at Joliet, Ill.

Mr. T. Winkel has been appointed master mechanic of the Gulf division of the International & Great Northern, with office at Palestine, Tex.

Mr. J. H. Bender has been appointed master mechanic of the Denver, Laramie & Northwestern, with office at Utah Junction, Denver, Colo.

Mr. G. H. Bussing has been appointed superintendent of motive power of the Mexico North Western, with headquarters at Madera, Mex.

Mr. W. J. Dovitt has been appointed roundhouse foreman of the Rock Island, with office at McFarland, Kan., in place of Mr. F. L. Coles, promoted.

Mr. J. F. Hill, formerly shop superintendent of the Wheeling & Lake Erie at Brewster, Ohio, has been appointed master mechanic, with office at Brewster.

Mr. Newton Cage, formerly assistant road foreman of engines of the Connellsville division of the Baltimore & Ohio, has been appointed road foreman of engines.

Mr. James Ashcroft has been appointed as road foreman of engines on the Grand Trunk Pacific, covering the territory from Transcona to Melville and the Yukton Branch.

Mr. J. A. Wilkings, machine shop foreman of the Southern Railway Company, Knoxville, Tenn., has been promoted to roundhouse foreman at Selma, Ala., in place of Mr. C. W. Anderson.

Mr. F. C. Pickard has been appointed master mechanic of the Buffalo division of the Delaware, Lackawanna & Western, with office at East Buffalo, in place of Mr. F. G. Colwell, resigned.

Mr. H. J. Osborne has been appointed master mechanic of the Louisiana division of the Rock Island lines, with headquarters at Eldorado, Ark., in place of Mr. W. F. Moran, transferred.

Mr. W. J. O'Neil, formerly master mechanic of the Rock Island, at Little Rock, has been transferred to Chickasha, Okla., in place of Mr. C. A. McCarthy, who has been transferred to Shawnee, Okla.

Mr. S. J. Dillon, formerly master mechanic of the Trenton Terminal, at Camden, N. J., has been appointed master mechanic of the West Jersey & Seashore and the Camden Terminal, at Camden.

Mr. Robert C. Falconer has been appointed principal assistant engineer of the Erie lines east of Salamanca, N. Y. He will have charge of the Drafting Room and Cement Testing Bureau.

Mr. W. Murphy has been apointed night engine house foreman of the Missouri, Kansas & Texas, at Dallas, Tex., and Mr. E. Owens has been appointed general foreman on the same road at Gainesville, Tex.

Mr. C. E. Lindeman, formerly apprentice instructor of the Santa Fe, at Richmond, Cal., has been appointed machine foreman at La Junta, Cal., and Mr. W. B. Lyons, has been appointed machine foreman on the same road at Bakersfield, Cal.

Mr. G. E. Johnson has been appointed division foreman of the Santa Fe, at Gallup, N. M., in place of Mr. E. M. Sanjule, who has been appointed general foreman of the same road at Riverbank, Cal.

Mr. E. C. Buckwell, secretary and manager of sales of the Cleveland Twist Drill Company, sailed for Europe last month on a two months' business trip. Mr. Buckwell has the happy faculty of combining business with pleasure.

Mr. G. W. Clark has been appointed locomotive foreman of the Grand Trunk at St. Lamber, Que.; Mr. W. H. Walker has been appointed locomotive foreman at Turcot, and Mr. L. J. McLaughlin has been appointed locomotive foreman at Brockville.

Mr. E. F. G. Meisinger has been assigned that territory west of the Rocky Mountains in the railroad department of the S. E. Bowser & Company, whose oil storage system has come into much popular favor. Mr. Meisinger is eminently qualified for the position.

Mr. W. S. Wilcox has been appointed roundhouse foreman of the Kanawha & Michigan, at Middleport, Ohio, in place of Mr. C. D. Rafferty, appointed general foreman of the locomotive department, and Mr. C. B. Hottice has been appointed erecting shop foreman, also at Middleport, O.

Mr. R. J. Sheridan, formerly with the purchasing and supply department of the New York, New Haven & Hartford, has been appointed Eastern representative of the Chicago Railway Equipment Company, with office at 30 Church street, New York, in place of Mr. C. P. Williams, resigned.

Mr. E. W. Strong, of the department of publicity of the American Locomotive Company, New York, has resigned to accept a position with the American Vanadium Company, of Pittsburgh, Pa. Mr. Strong has been connected with the American Locomotive Company since its organization in 1901.

Mr. H. H. Briggs has been recently added to the list of railroad salesmen in the employ of S. E. Bowser & Co., Fort Wayne, Ind. Mr. Briggs is a railroad man of wide experience. His territory will be in the Southwest where the Company's oil storage system is coming rapidly into popular favor.

Mr. J. R. Cook has been appointed general foreman of the Santa Fe shops at Clovis, N. M., and Mr. J. Z. Kuhns has been appointed roundhouse foreman to succeed Mr. Cook. Mr. R. T. Gorman has been appointed roundhouse foreman at Needles, Cal., and Mr. R. Benedict as roundhouse foreman at Bakersfield, Cal., both on the same road.

Col. Levi R. Greene, for over forty years connected with the Walworth Manufacturing Company, Boston, Mass., received many congratulations last month on attaining his eightieth birthday. He has all the alertness of middle life, and is a fine type of the robust New Englander. He has done much excellent work as an engineer, and much more may yet be expected from him.

Mr. G. R. Beyer has been appointed assistant superintendent locomotive fuel service, on central division, St. Louis and San Francisco, in place of Mr. J. E. Smith, assigned to other duties, and Mr. W. J. Kelsey has been appointed assistant superintendent locomotive fuel service on Rolla subdivision of the eastern district, St. Louis and San Francisco, with office at St. Louis, succeeding Mr. Beyer.

Mr. N. L. Robinson, formerly road foreman of engines of the Baltimore division of the Baltimore & Ohio, has been appointed supervisor of fuel consumption. Mr. Robinson is succeeded as road foreman of engines at Baltimore by Mr. E. C. Shipley. Mr. Robinson is a graduate of Purdue University, and is a mechanical engineer of recognized ability. He has done excellent work as a member of the General Safety Committee.

Mr. C. H. Terrell, superintendent of motive power of the Chesapeake & Ohio at Huntington, W. Va., has been appointed assistant superintendent of motive power with office at Richmond, Va., and Mr. W. P. Hobson has been appointed master mechanic of the Cincinnati division, and Mr. H. M. Brown has been appointed shop superintendent at Huntington, W. Va., of the same road. The power on the several divisions has been discontinued.

Miss Helen Gould is untiring in acting the fairy bountiful for needy benevolent institutions. The Young Men's Christian Associations doing good work among railroad men are the peculiar objects of Miss Gould's bounty. Her latest aid was to the erection of a building in Portsmouth, Miss. She has given altogether, $25,000 to help that institution. The last $15,000 was given as a memorial to her cousin, William Northrop, of Virginia.

The Joseph Dixon Crucible Company, of Jersey City, at a meeting last month made the following changes in the officers and board of directors: Mr. George E. Long, former treasurer, was elected vice-president, to succeed Mr. Corbin; Mr. J. H. Schermerhorn, former assistant secretary and assistant treasurer, was elected to membership in the board of directors and treasurer of the company. Mr. Albert Norris was elected to the office of assistant secretary and assistant treasurer.

Mr. Mark A. Ross, manager of the Pyle National Electric Company, Chicago, has resigned. Mr. Ross has had a notable career as an all-round railway man, and representative of several leading railway supply firms, and has been especially active in mechanical associations, and has served as president of the Railway Supply Manufacturers' Association. He is still in the prime of life and his future cannot be other than a continuation of his active and useful career.

Mr. George H. Baker has been appointed by President Worthington fuel director of the Chicago & Alton Railroad. Mr. Baker is one of the ablest experts relating to combustion in locomotive fire boxes to be found anywhere, and he will not be to blame if the Chicago & Alton enginemen fail to take a prominent place among those who make their engines perform a maximum of work on a minimum of coal. Mr. Baker began his connection with locomotive work by firing on the Chicago & Alton Railroad. He has been managing a railway educational school in Brooklyn, N. Y., for some years.

Mr. Frank A. Chase.

Among the many railroad men who worked their way upwards from the lowest step of the ladder of life to responsible positions was Mr Frank A. Chase, who rose to be mechanical inspector of the Chicago, Burlington & Quincy, but is now

F. A. CHASE.

retired and living at ease and comfort in Los Angeles, Cal. Mr. Chase was born at Monroe, Ohio, in 1836, so he is now 76 years old, 61 years of which were spent following railroad work, 45 of them with the Burlington system. Like many other prominent railroad men Mr. Chase entered the service as a train boy on the Sullivan Railroad of New Hampshire, which he left to become a machinist apprentice in a manufacturing establishment in Vermont. When his apprenticeship was ended he went South and for a time worked in the South Carolina Railroad shops at Charleston, S. C. The war excitement moved him to the Detroit Locomotive Works, where he remained till 1868, when he entered the employ of the Chicago, Burlington & Quincy Railroad at Aurora, Ill., as machinist. Afterwards he became roundhouse foreman on the same road, and passed through the grades of locomotive engineer, roundhouse foreman, master mechanic and finally general mechanical inspector.

Obituary.

WILLIAM H. CORBIN.

We regret to anounce the death of Mr. William Horace Corbin, the esteemed Vice-President of the Joseph Dixon Crucible Company. Mr. Corbin had earned an enviable reputation as an able and accomplished man of business, and was for many years counsel for the Company of which he was an honored member. The sad event occurred on September 25.

CHARLES W. BUCHOLZ.

Mr. Charles W. Bucholz, chief engineer of the Erie Railroad, died at his residence, Hempstead, Long Island, on October 20. He was an accomplished engineer and his death is very much regretted by his fellow officers and associates, among whom he was very much esteemed.

Erie Meeting.

A system of committee meetings of the officials belonging to the mechanical department by the Erie Railroad has been instituted by Mr. Wm. Schlafge, general mechanical superintendent. The committees discuss all subjects that are likely to bring useful information to those taking part, hence for the good of the service. The following officials were requested to attend a meeting at Meadville, beginning October 30: Messrs. W. C. Hayes, superintendent locomotive operation; Angus Sinclair, special instructor; A. G. Trumbull and E. S. Fitzimmons, mechanical superintendent; E. A. Wescott, superintendent car department; F. S. Brown, mechanical engineer; W. S. Cozad, superintendent apprentices and piece work; H. S. Burr, superintendent of stores; T. W. Dow, general air brake inspector; H. L. Bunhus and A. Nunn, inspectors tools and machinery; F. A. Griffin and G. P. Patrick, general foremen boiler makers; Robert Gunn, consulting engineer; J. McMullen, A. Trautman and J. T. Munroe, shop superintendents; P. J. O'Dea, general inspector, and R. H. Oakley, inspector. Mr. Schlafge presides at the principal sessions and there is very frank and free interchange of ideas. We expect to report these meetings for the benefit of our readers.

Air Brake Association.

The twentieth annual convention of the Air Brake Association will be held at St. Louis, Mo., May 6, 7, 8, and 9, 1913. The headquarters will be at the Planter's Hotel.

Fired.

"A crank to see you sir, about a new invention. I can't get rid of him. He's on fire with enthusiasm."

"Well, put him out."

Traveling Engineers' Convention

Address by Mr. J. M. DALY, General Superintendent of Transportation, Illinois Central Railroad.

We have had the pleasure of reading many valuable articles and addresses on Tonnage Rating and similar themes relating to train movements, but that delivered by Mr. Daly before the Traveling Engineers' Convention was the most comprehensive of any that have come to our notice and it gives us much pleasure to publish the greater part of the address as follows:

TO HANDLE THE TRAFFIC ECONOMICALLY.

There are two important economical problems yet to solve, one is the Maximum Economical Rating and Loading of Locomotives, and the other is the Reducing of Empty Car Mileage through the Pooling of Equipment. It is just and necessary for our railroad companies to ask us to handle the traffic economically in order that their net revenues may be increased, from the fact that the net earning capacity of the roads has been greatly reduced by legislative action, the cost of every article used by the railroads, including wages, has rapidly increased, and unless new economies can be made effective in order to keep pace with these reductions, the only result possible is bankruptcy. When the crusade on reduction of rates and more expensive service obtained real momentum about 1900, the railroad experts, got busy on economical methods, notably as follows: First, by the reduction of grades and the elimination of curves; second, by the use of larger capacity cars; and third, by the introduction of larger locomotives. While some properties were fortunate enough to be able to dispose of bonds and stock and raise money to take advantage of these improvements before, as well as since 1900, fully 80 per cent of the roads are not at the present time equipped for economical operation, due almost entirely to the fact that their source of revenue has been curtailed far beyond the limit of good business policy, both as affecting the owners and employees, as well as the public.

CAR LOADS AND TRAIN LOADS.

Admitting that the roads require economy from the department controlled by the Traveling Engineer, it is well to carefully analyze the factors that create train resistance and determine what is necessary to be done in order to obtain increased efficiency in the loading of trains. In order to do this, it is necessary to briefly review the methods used in loading trains in the past. Records show that in 1870 the carrying capacity of freight cars was about 24,000 lbs.; today it is 100,000 lbs., an increase of 400 per cent. In 1870 the average weight of a car was 16,000 lbs., or 66 per cent. of its capacity, whereas today, a 100,000 lbs. capacity car weighs only 40,000 lbs., or but 40 per cent. of its capacity. In 1870 trains were made up on the basis of a given number of loaded cars, and if empty cars were in a train they were rated at two empties equal to one load. Later on this was modified and three empties were considered equal to two loads. This was a reasonably accurate basis due to the uniform capacity and loading of cars moved in tonnage trains, but with the adoption of the large capacity cars, the car basis had to be abandoned and the gross ton basis adopted. About 1895 with the introduction of the large 50-ton capacity coal car, the Hocking Valley R. R. found it impracticable to load engines on the basis of number of cars, as trains with 50-ton capacity cars invariably stalled. This condition necessitated a change, and the gross ton basis was adopted. Immediately on the adoption of the gross ton basis, it was found that an engine rated at 2,100 gross tons when hauling 30-ton capacity cars, gross weight per car 50 tons, had its maximum load with 42 cars or 2,100 tons, whereas the same engine could easily handle 30 cars of 70 tons each, although the gross weight of both trains was the same; hence it then became necessary to equate the tonnage of cars on the basis of the gross weight of each.

CRAWFORD'S METHOD.

About this time Mr. D. F. Crawford, superintendent of motive power of the Pennsylvania R. R., devised a plan to make an arbitrary car allowance to meet the variation in gross weight of cars. This plan is to test engines with a train made up of all light empty cars and another test of the heaviest loaded cars, then divide the difference in the gross tons hauled by the difference in the number of cars hauled, and then to add the result arbitrarily to the actual weight of each car. It was about 1895 that I first began to investigate this problem, and I assure you it was found to be a very interesting as well as a very complicated one to handle. While each of you have met with the same difficulties, it may be well to review some of them at this point. For instance, the placing of heavy loaded cars at the head end of train; the making of a different allowance per car according to the grades and curves; the reduction of rating on districts having light rail in spring, when the track is soft, due to depressions at joints, especially with heavy capacity cars; the resistance due to cold weather freezing the lubrication in the journal boxes; increased wind resistance as the length of train is increased.

EFFECTS OF LIGHT RAILS AND POOR TRACK.

The factor of light rail and poor track surface was brought out clearly in 1900, when I was connected with the Delaware, Lackawanna & Western R. R. The presidents of the Delaware, Lackawanna & Western and the New York, Ontario & Western roads were discussing the saving to be obtained from the use of large cars and engines. Each thought he had the better engine. I succeeded in getting them to permit us to make a pulling test. We took one of the Lackawanna engines over to the Ontario & Western line, gave it a tank of the same coal the latter engines received, and a train of coal, mostly heavy cars, was made ready, and the N. Y., O. & W. engine made the first trip up the Carbondale, Pa., hill; this in order to permit our engineer to get familiar with the grade. The gross tonnage in this train was the same that their engine had demonstrated it could handle without any trouble, but on this test trip it stalled about one-half mile from the top of the mountain. The train was backed down and our engine took it. We stalled about 200 feet below the point their engine stopped. The next day they brought their engine over on our rails and we took the train of heavy cars up Pocono Mountain, 21 miles, in 35 minutes less time than their engine used, both engines having cleared without stalling. Another test was made on our tracks with light loaded cars with the same total tonnage, both engines hauled the previous day, and engines stalled in less than three miles from starting point. This demonstrated the fact that on the Lackawanna the engines could haul about 20 per cent. more tonnage in heavy capacity cars than it could haul in light capacity cars, whereas the reverse was the condition on the Ontario & Western road.

We then made another test on the Ontario & Western with a full tonnage train of cars averaging 55 gross tons, and the engine had no trouble in hauling it over the grade, whereas with 70 gross ton cars it was stalled. This required an investigation and it was a conductor that solved it for us by showing that the heavy cars depressed the rails at joints and made an increased up-hill pull or, as he stated, it made waves in the track at the rail joints due to light rail, poor ballast and surface. This instance is cited merely to show that the building of large capacity cars of itself would increase the expense of transportation, unless additional money was spent for the heavier rail and better roadbed, points which the public does not give proper consideration.

DIGEST OF TRAIN TONNAGE.

Having considered the necessity for increasing the average train load and the

past methods employed, let us now take up the present practice. The American Locomotive Company has published a very elaborate and complete digest on train tonnage, tables being given which show in detail the pounds of tractive power used to move a gross ton over the different grades, also showing clearing that wheel friction is the one important factor to be considered, conceding of course that trains will be built up properly on terminals with the heavy loads at the head end. Mr. Cheeney of the Chicago, Milwaukee & St. Paul Ry., has devised the plan of loading engines on the basis of pounds of tractive power used instead of gross tonnage, which is a very accurate basis. The objection to this plan is the amount of clerical time required in busy yards to compute the tonnage. This, however, can be overcome by reducing the pounds of tractive power used per car to the ton unit and by using a properly adjusted computing machine. The last but most important feature in connection with the problem is to see that trains are properly loaded under any plan adopted. My experience leads me to believe that the work of the mechanical engineer, the traveling engineer and other operating officials in determining the resistance per ton of car, and other factors previously stated, is the easy part of it. The difficulty is in having the terminal forces build up trains properly and with the assigned tonnage.

EQUATE THE TONNAGE OF CARS.

The ideal method to increase the train load is to equate the tonnage of cars, then arrange for the switching department to properly build up the train, and, when ready, have the yard clerk check the track, go to the office, pull the bills, foot the tonnage on the train resistance computer, notify the yard what tonnage to add on or take off, have bills ready for the conductor when he calls and avoid delaying the train in departing, which will save in overtime and fuel and often permit another train to pull in on the track cleared. After the departure of the train, the yard clerk can enter on his daily tonnage report the train number, number of cars hauled, the rating of the engine and the equated tons hauled. A copy of this report should be sent to the superintendent or the trainmaster at the close of each day in order that he may investigate at the time the cause of failure to properly load the individual train instead of investigating the matter 30, 60 or even 90 days later when the terminal is not in position to make an accurate explanation.

EFFECT OF 16-HOUR LAW.

The 16-hour service law has materially affected the handling of tonnage and frequently when trains are given their assigned tonnage, and it happens to be largely in light capacity cars, it results in dragging over the road and very frequently in the train being tied up on the line on account of this law, thereby creating considerable expense instead of resulting in a saving. This condition can be largely overcome through the equated basis of loading engines, as under that plan the draw-bar pull of all trains is equalized so that it is impracticable to have one train exert 40,000 lbs. of tractive power as compared with another train with same tonnage exerting only 32,000 or 34,000 lbs., and by loading the trains with uniform draw-bar pull, engines should be able to handle them within the time allowance.

WEATHER FACTOR.

Another factor which has been given considerable thought and on which a large number of tests have been made by some roads is the weather or temperature factor. Tests have been made of the resistance of different weights of cars at 30 degrees above and at different stages from that down to 20 degrees below zero, but personally I do not consider them as of much importance in practical operation for several reasons; first the temperature may be 20 above zero with a drifting wind which is carrying snow into the cuts, making it much more difficult to operate than if the temperature was zero and calm. Again the temperature at the initial terminal point may be 20 degrees above and calm, whereas 50 miles out in the direction the train will move, it is snowing, drifting and down to zero. Again, at certain terminal points where they are fortunate enough to be located on an elevation where they get the benefit of down-grade or momentum in leaving the terminal, an engine at zero temperature can haul 300 or 400 tons more than if the terminal were located in a sag where there is a slight grade leaving the terminal for the reason that the lubrication congeals when trains stand a few hours in the yard waiting for movement and creates considerable resistance on the journals in starting the train, which continues until such time as the heat of the motion of the jouranls warms up the oil. Therefore, I feel that the question of loading engines in extreme cold and stormy weather is one which must be left largely to the discretion and good judgment of the men on the ground.

CROWDED TRACK FACTOR.

Another factor in connection with the rating of engines which should receive consideration is the making of some slight allowance for trains moving on busy tracks where there is a large number of superior class trains to keep out of the way of, in order that the train may cross over on double track or take sidings and get out with dispatch, instead of being obliged to frequently double out, thereby delaying the passenger trains. In other words, an engine with 40,000 lbs. of tractive power on a one-fourth per cent. grade on one division may be able to handle regularly 3,000 gross tons, whereas on another division where they have heavy traffic, it would be economy to reduce this tonnage to possibly 2,800 tons on account of the number of trains to be met so that the physical conditions on the individual division or train district must be considered in the rating of the power. An arbitrary set of figures will not apply successfully at all points. In conclusion I wish to say that in my judgment more money is lost in overloading the power than in underloading it, and that the only safe and economical method for obtaining the 100 per cent. efficiency is in using the equated basis.

Individual Scoops for Firemen.

On most railroads where the practice of pooling the locomotives is in vogue the firemen have difficulty in keeping possession of scoops, nearly every fireman preferring to use the scoop he is accustomed to. According to the *Ry. and Engineering Review,* as a feature of the fuel economizing practice on the Iowa division of the Chicago & Northwestern Ry., the firemen are provided with individual scoops, the advantage of which to those familiar with locomotive firing methods is at once evident. Instead of obliging the fireman to store their scoops in their lockers, which for a variety of reasons may be impracticable, there has been provided at the Boone, Ia., roundhouse, a means of storing these shovels which remind one somewhat of the racks that used to be provided for the storing of bicycles or of the hitching rails of the village store. As a matter of fact, except that a narrow roof is provided to protect the shovels from accumulations of sleet and snow in the winter time, the scheme is identical with the hitching rail, consisting of a length of pipe between two or more wooden posts. The firemen secure their shovels to this rail by means of a short piece of chain and a lock, which latter they provide at their own expense. The fireman retains the key and is reasonably assured that his favorite scoop will be available each time he is called out on his run.

Energy equals power to do work. Work is the overcoming of resistance. The amount done is measured as the resistance overcome and the distance moved through space. The resistance is measured by pounds and the distance by feet. The product is called foot pounds.

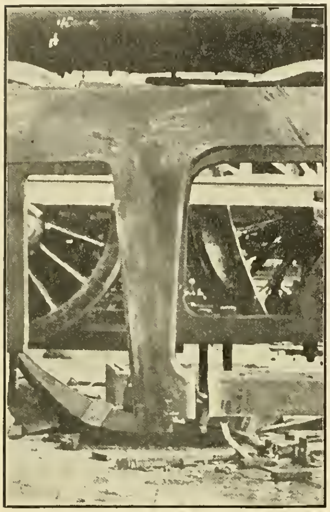
Above all, set to work to get life out of a living instead of wasting a life in merely getting a living.

Business always comes quickest to the man who goes the farthest to meet it.

WELDING IN HEAVIER FRAMES

Interesting Welding Operations at the Wheeling and Lake Erie Railroad Shops, Brewster, Ohio.

The accompanying illustrations show the method followed by the Wheeling

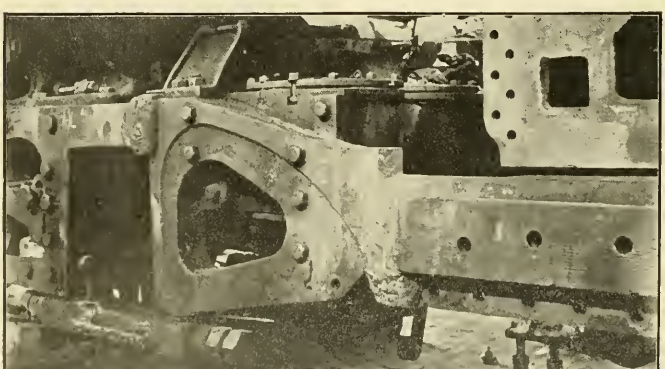


FRAME CUT OUT FOR WELDING.

and Lake Erie Railroad in welding in heavy frame sections to replace lighter ones. This road had considerable trouble recently with frame failures, particularly on large freight engines, and as a result they are replacing a number of their light frames with heavy ones, and in doing so utilize the Thermit process, as this method enables them to execute the repairs without dismantling the locomotive to any considerable extent and also with the least amount of delay and expense. Engine No. 2145 represents a typical repair of this character.

In some cases, however, fractures in frames are welded with Thermit without adding new sections, and a recent repair of this kind was made on engine No. 2111. The weld had to be made at the edge of the cylinder and partly under it, and as it was feared that the intense heat might crack the cylinder it was decided to remove this cylinder before executing the repair. The fracture was quite a long one, requiring 150 pounds of Thermit.

All the Thermit work in these shops is executed under the direction of Mr. Max Blum, foreman blacksmith, who states that they have been using the process since 1909 and have only had one weld fail in that time, which they found to be due to the frame not having been spread a sufficient amount to allow for contraction. It is their practice to do all necessary cutting of metal, removing gates and risers of welds, etc., with the oxy-acetylene cutting flame.



THERMIT WELD IN RIGHT FRAME OF ENGINE NO. 2111. WHEELING & LAKE ERIE RAILROAD SHOPS, BREWSTER, OHIO.

Christian Endeavor Receive Money Belonging to Master Car Builders' and Master Mechanics' Associations.

There is tribulation in the Atlantic City Hotel Men's Association through a circumstance partly explained in a letter from Joshia White & Sons Co. to Mr. A. C. Poffenberger, treasurer of above association. Extract from the letter read:

"Broadly and without any desire to say anything unpleasant we had hoped by retaining this fund to prevent the use of moneys belonging to the Master Mechanics' and Master Car Builders' conventions to pay debts incurred for the Christian Endeavor Association convention. We consider that the 10 per cent. paid by hotels entertaining the Master Mechanics' and Master Car Builders' conventions morally if not legally belong to them and should be applied for the benefit of those conventions. While the hotels pay over

to the Hotel Association 10 per cent. of the board accounts for these meetings, the money nevertheless comes out of the pockets of the members of these conventions, and in taking that money and applying it for the purpose

FINISHED WELD, SHOWING METAL AFTERWARDS REMOVED.

of the Christian Endeavor Association appears to us to be morally a misappropriation of funds no matter what it may be legally.

"You will recall that there was a surplus in your hands as treasurer of the Hotel Association of more than $1,000 in the account of the Master Mechanics' and Master Car Builders' conventions, and that under the direction of the Hotel Men's Association this money was paid by you into the account of the Christian Endeavor Association.

"I now learn that the Publicity Bureau, of which Mr. Lenhart is secretary-director, had a surplus in the account of the American Medical Association convention for 1912 of over $2,000, and that this money contributed from the payments of the American Medical Association members was taken out of the account of that association and paid over to the account of the Christian Endeavor Association, so that I understand that up to the present time more than $4,000 has been used for the benefit of the Christian Endeavor meeting of 1911 out of moneys contributed by the Master Mechanics' and Master Car Builders' people and by the doctors attending the American Medical Association of 1912.

"The Master Mechanics' and Master Car Builders' convention account is now found to be short some $2,000, but on account of the improvident use of a surplus which they previously had there is no way of meeting this shortage, and their convention for 1913 is in danger of being lost to Atlantic City because of the injudicious policy which the Hotel Association has pursued. You cannot expect the hotels to continue to place money in the hands of the Hotel Association to be spent for the use of the Master Mechanics' and Master Car Builders' convention if there is danger of violating the trust imposed in them to properly apply the funds by paying them over to some religious convention whose value to the city is nothing compared to that of the railroad conventions. The same is true of the American Medical Association funds. It is certainly doubtful if the hotels as a whole will ever contribute again to the Publicity Bureau moneys to be used for the benefit of the American Medical Association if those funds are liable to be changed over and used for religious purposes."

The Swan and the Crane.

A beautiful swan alighted by the banks of the water in which a crane was wading about seeking snails. For a few moments the crane viewed the swan in stupid wonder and then inquired: "Where do you come from?"

"I came from heaven," replied the swan.

"And where is heaven?" asked the crane.

"Heaven," said the swan, "heaven! Have you never heard of heaven?" And the beautiful bird went on to describe the grandeur of the eternal city. She told of the streets of gold and the gates and walls made of precious stones; of the river of life, pure as crystal, upon whose banks is the tree whose leaves shall be for the healing of the nations. In eloquent terms the swan sought to describe the hosts who lived in the other world, but without arousing the slightest interest on the part of the crane.

Finally the crane asked, "Are there any snails there?"

"Snails!" repeated the swan, "no! of course there are not."

"Then," said the crane, as it continued its search along the slimy banks of the pools, "you can have your heaven; I want snails!"

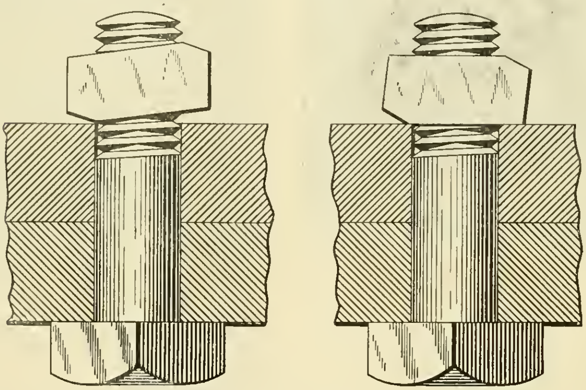
And so thoughts of material utility push aside thoughts of bliss to come.

Barges of reinforced concrete are being used on the Panama Canal because they cost less than steel and only a little more than timber. The ordinary flat-bottomed type is used, and the overall dimensions are 64 ft. x 24 ft. x 5 ft. 6 7/16 in. maximum depth. There are two longitudinal bulkheads, and lateral frames, 10 ft. apart, strengthen the construction.

A New Lock Nut.

The Dieter Nut Co., 84 William street, New York, is introducing a new patented nut for which is claimed a number of points of superiority, prominent among which is the eliminating of a nut lock.

The nut consists of a single piece, pierced and tapped at an angle to its face, so that when it is screwed into place, one side of the face first touches the surface against which it is to rest. As it is then further screwed down, the pressure becomes not only a lifting force, but at the same time, the bolt is gradually deflected and the eventual result when the nut is finally forced "home" is that the face of the nut is flat upon the surface and the bolt is canted to such a degree that the nut cannot back off unless purposely removed.



NEW LOCK NUT SHOWING ANGULARITY OF NUT.

Oriental Grievances.

There are many grievances endured by railroad men on the American Continent, but they seem to be light compared to the hardships endured by railroad men in India. The *Railway Times,* of India says: "Men all over the line are crying for 'leave', but leave is seldom granted. The railway authorities squeeze the sap out of their employees and when nothing is left give them the sack. There is little enough left in a railway servant at the best of times owing to the hard work he has to put up with, and the railway authorities might be a little human and give their faithful servants a just reward when the time comes."

Hobson Groaned.—"What's the matter, old chap?" inquired a friend kindly. "Oh! ach! My wife can't sing!" moaned the miserable man. "Can't sing?" exclaimed the friend cheerfully. "My dear chap, in that case I should have thought you were to be congratulated." The poor wretch shook his head sadly. "Can't sing," he echoed dully; "but thinks she can!" And they sat down side by side and wept together.

RAILROAD NOTES.

The Mexican railway has ordered 8,800 tons of steel rails from the Maryland Steel Company.

The Chicago Great Western has ordered 5,000 tons of steel rails from the Illinois Steel Company.

The Erie is reported to have ordered 25,000 tons of steel rails from the Carnegie Steel Company.

The Denver & Rio Grande has ordered six Pacific locomotives from the Baldwin Locomotive Works.

The Duluth and Iron Range has ordered 2,500 tons of rails from the Illinois Steel Company.

The Santa Fe is planning new yards with machine shops and a roundhouse at Wichita, Kan.

The Chicago, Rock Island & Pacific is building a 20-stall engine house at Manley Junction, Ill.

The Wabash is said to have ordered the 20,000 tons of steel rails that it has been inquiring for.

The Northern Pacific, it is said, has ordered 60 locomotives from the American Locomotive Company.

The Washington Southern has ordered 5 Pacific locomotives from the Baldwin Locomotive Works.

The Atlantic Coast Line has ordered 20,000 tons of rails from the Tennessee Coal, Iron & Railroad Company.

The New York, New Haven & Hartford has ordered six Pacific locomotives from the Baldwin Locomotive Works.

The Missouri, Kansas & Texas has or-

dered 40 Mikado locomotives from the American Locomotive Company.

The Louisville & Nashville has ordered 10.000 tons of structural steel to be used for car construction in its own shops.

The Minneapolis, St. Paul & Sault Ste. Marie has ordered 65,000 tons of steel rails from the Illinois Steel Company.

The Union Pacific is about to construct a 28-stall engine house with coaling station and water tank at North Platte, Neb.

The Wabash has decided to proceed at an early date with the construction of new locomotive repair shops at Decatur, Ill.

The Northern Pacific has begun the building of a 40-stall roundhouse, machine shops and division offices at Carlton, Minn.

The Lehigh & New England has ordered 5 Consolidation and 1 eight-wheel switcher from the Baldwin Locomotive Works.

The Michigan Central is building a new 40-stall engine house at Bay City, Mich., and the new machine shops will be largely increased.

The Chicago, Milwaukee & St. Paul is building a 40-stall engine house at Sioux City, Iowa, and the car shops there will be enlarged.

The Louisville & Nashville, it is reported, has placed orders for 70,000 tons of steel rails with the Tennessee Coal, Iron & Railroad Company.

The Canadian Northern Pacific will construct a new branch line from the mouth of the Fraser river, B. C., northeast to Yellow Head Pass, 525 miles.

The Central of New Jersey has ordered 12.000 tons of rails from the Pennsylvania Steel Company, and an equal amount from the Bethlehem Steel Company.

The Baltimore & Ohio has ordered 500 steel underframes from the Pressed Steel Car Company, and 500 steel underframes from the Ralston Steel Car Company.

The Chicago, Milwaukee & St. Paul, it is said, has closed for 65,000 tons of steel rails for 1913 delivery. The road was said to be in the market for 125,000 tons.

The Erie has purchased the Pacific locomotive No. 50,000, which was built by the American Locomotive Company, and has been the subject of much experimental work.

The Minneapolis & St. Louis is building a 15-stall engine house at Oskaloosa, Iowa. A machine shop and boiler shop are included in the design of the engine house.

The Reid Newfoundland Company are building new branches from St. Johns to Trepassey Bay, a distance of 80 miles, and from Broad Cove to Heart's Content, 35 miles.

The Minneapolis, St. Paul & Sault Ste. Marie has ordered 10 mikado freight locomotives from the American Locomotive Company. These locomotives will be equipped with superheaters.

The Southern Pacific is about to construct new machine shops at South Portland, Ore., and the shops at Tucson, Ariz., will be enlarged to permit repairs of the largest locomotives.

The Southern Railway is making rapid progress in extending the double track line north of Atlanta. It is expected that by the end of the year the double track will be completed to Washington and Atlanta.

The Pennsylvania Lines West, it is stated, has completed plans for the extension of its Yukon branch so as to make connections with the Pennsylvania at Cowansburg. The road will penetrate a large coal field.

The Cleveland, Cincinnati, Chicago & St. Louis are making extensive additions to the repair shops at Springfield, Ohio. Additions will also be made to the shops at Beech Grove, Ind., and a new engine house will be erected at Elkhart, Ind.

The Richmond, Fredericksburg & Potomac has ordered five superheater Pacific passenger locomotives, with 22 x 28-in. cylinders, driving wheels 73 ins. in diameter and a total weight of 241,000 lbs. in working order, from the American Locomotive Company.

The Western Maryland is said to be considering the construction of a branch line from Connellsville into a projected coke development in Ligonier and Cook townships, Westmoreland county, and the southeastern portion of Indiana county along the Conemaugh river.

Men have a trick of coming up to what is expected of them, good or bad.

Books, Bulletins and Catalogues

Case Hardening.

The Ideal Case-Hardening Compound Company, 1784 Broadway, New York, have issued a fourth edition of their popular book of useful information and practical rules on case-hardening, pack-hardening, and annealing of steel. The rules and instructions given are not based, as such works often are, on accepted theories, but are a condensed and clear reflex of the best practice in the leading shops and factories, and the book has been already endorsed by a large number of prominent men engaged in case-hardening operations in the United States and abroad. To those not familiar with the subject there is added in the new edition a brief general discussion which will prove of interest. Copies of the book may be had free on application.

Railway Lamps.

The Dressel Railway Lamp Works has issued Catalogue No. 14, which extends to 72 pages, describing and illustrating their fine products which embrace every kind of railway lamp with attachments from the Automatic Deck Caboose lamp to the tower lamps, embracing about 50 varieties of lamps. Among the recent additions to the designs are the Lift Bridge lamps, made of steel and turned. It should be borne in mind that among the recent United States government regulations, strict provisions are made that bridges shall be provided with numerous lamps. The Dressel company has met these regulations with a promptitude and completeness that leaves nothing further to be desired. Whenever the bridge is opened or closed the lamp is made to swing by gravity, while the light displays the proper signal through red or green glasses permanently attached to the bridge. The catalogue is the most complete of its kind yet published, and all interested may secure copies by addressing the company's office, 3860 Park avenue, New York City.

Hydraulic Accumulators.

Catalogue No. 84 has just been issued by the Watson-Stillman Company, and consists of 56 pages of descriptive matter tabulating and fully illustrating and explaining seven principal types of hydraulic accumulators which the firm manufactures. A portion of the catalogue is also devoted to accumulator accessories and to special hydraulic testing apparatus, reservoirs, press systems, duplex or continuous intensifiers, hydraulic pumps and punches, and die sinkers' hydraulic tools. Copies of the catalogue may be obtained on application to the company's main office, 50 Church street, New York.

Tool Holders.

The Armstrong Brothers Tool Company, Chicago, have just published a new Catalogue, A-12, which contains 125 pages of descriptive matter fully illustrated, embracing their extensive variety of machine shop appliances. Practical machinists have long recognized the efficacy of the Armstrong tool holders, in fact, their value can hardly be overestimated. In convenience, economy and efficiency it is one of the leading appliances in machine construction and repair. The Armstrong system includes tool holders for every operation on the lathe, shaper, slotter or drill press. Their complete equipment pays for itself in a short time, and the popular favor which has come to the enterprising company, has induced the invention of many other valuable devices, among the more recent being an adjustable clamp drilling post, which fills a long-felt want and is meeting with much favor. Copies of the new catalogue may be had on application.

A Railroad Dog.

What's come of your dog? inquired a visiting trackman of Jerry Sullivan, a gang boss on the line.

He's dead, replied Jerry with a sigh, got killed.

How did it happen?

Well, this dog of mine was what they call a pointer and he learned to point out all the low joints. One day the road master was riding over the section on a hand car and my pointer dog was running ahead looking out for low joints. He happened to see a bad one and in trying to hide it from the road master he squatted upon it and was run over.

Tortillas in Mexico.

The Mexicans use the tortilla not only as a food, but make it serve also as fork and spoon. It is folded into a sort of scoop and used in eating beans, thick soup, rice, hash or anything else usually lifted to the mouth with fork or spoon. Many of the poorer classes are not accustomed to the use of knife, fork or spoon. Tortillas are sold in large quantities in the market fresh and hot at six for 1 cent.

It is amusing, in the United States, the deference paid to sentiments expressed by the Scottish poet, Robert Burns. The writer, during the past year, has attended eleven public banquets or dinners, most of them made up of railway men, which were closed by the singing of "Auld Lang Syne." It expresses good heart-to-heart sentiments.

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXV. 114 Liberty Street, New York, December, 1912. No. 12

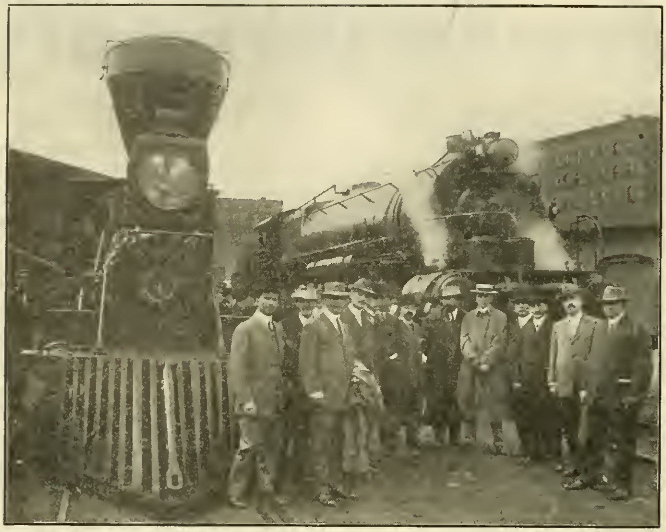
On the Great Northern Railway.

The growing popularity of the Great Northern Railway has been amply demonstrated during the year which is just closing, and the amount of freight that has passed over the road is far in excess of the record of any previous season. This is particularly true in regard to the amount of bread stuffs from the fertile fields of the Northwest. The general traffic manager claims that the records of the amount of wheat traffic passing over the road excels that of all of the other railroads having a terminal in Chicago, put together. The equipment has been supplemented by the addition of over one hundred new locomotives of the most powerful type, while the augmentations to the rolling stock are even proportionately greater. There are now over twelve hundred locomotives, and more than fifty thousand cars of various types. Among the locomotives it is interesting to observe that the "William Crooks," the oldest locomotive in the Northwest, and which was placed in service on the old St. Paul & Pacific Railroad in 1861, is still in service. We take pleasure in reproducing a photograph showing this pioneer locomotive which has a record of more than half a century of service, and with proper repairs bids fair to round out the century. As will be noted it is number one, on the company's list of locomotives, and is shown on a track immediately adjoining one of the new Mallet type of locomotives that are now being used by the Great Northern in hauling heavy train loads of freight on its mountain division. A group of magazine and newspaper men is shown, the central figure outlined against the right front cylinder of the Mallet being Mr. L. W. Hill, Chairman of the Board of Directors, who conducted the literary coterie over the road on a recent delightful excursion that will remain a pleasant memory to all who had the honor of participating in it.

THE "ORIENTAL LIMITED," GREAT NORTHERN RAILWAY, CROSSING THE MISSISSIPPI RIVER, ON THE STONE ARCH BRIDGE, BETWEEN ST. PAUL, MINN., AND MINNEAPOLIS, MINN.

The excursion was by the popular and luxurious train known as "The Oriental

Limited," and our frontispiece is a view of the train crossing the Mississippi river on the Stone Arch bridge between St Paul and Minneapolis. The bridge is double tracked and is a substantial and elegant structure. The Falls of St. Anthony are in full view of passengers on the Great Northern trains when crossing the bridge. The Oriental Limited is a magnificently equipped train in daily service between Chicago, St. Paul, Minneapolis, Spokane, Tacoma, Portland and North Pacific Coast cities. From Chicago the route of the Oriental Limited is almost due west to the Mississippi river and then for three hundred miles along the banks of the majestic waterway. The route is a very interesting one, following the windings of the Mississippi along historic old Indian trails, across fertile prairies, through the scenic mountains of Montana, skirting the edge of Glacier National Park, and over the rugged summits of the Cascade Range, and along the picturesque shores of Puget Sound.



THE "WILLIAM CROOKS," AND THE "BIG BULL MOOSER," WITH PARTY OF NEWSPAPER MEN, GREAT NORTHERN RAILWAY.

Apart from the continued chain of expanding cities with their teeming population, that cluster along the great railway, and the manifestations of agricultural wealth abounding in the richest profusion, there are several regions abounding in scenes of sublime beauty. One is the proposed Glacier National Park in the Rockies of Montana, and the other the Lake Chelan district in the Cascade Mountains. The Glacier National Park embraces 1,400 square miles. a territory somewhat similar in extent to the Catskill Mountains, while the compact clustering of the mountains within an area of about forty miles square is also similar. Otherwise there is little resemblance as the Catskills are only about four thousand feet in altitude, whereas the mountains in the Glacier National Park are nearly all over ten thousand feet above sea level. In the confines of the park there are over forty living glaciers and a great number of snow capped mountain peaks. From their source in these pinnacled peaks, sparkling cascades dash down the precipitous sides of massive basins between two and three thousand feet to the numerous deep, clear, cool mountain lakes, held gem like in huge settings of rock walled canons and evergreen mountain slopes. This region is twelve hundred miles west of St Paul, and is skirted on the south by the main line of the Great. Northern Railway.

McDERMOTT FALLS, GLACIER NATIONAL PARK.

The interminable lakes with which the country abounds add a brightness and a beauty to the scenery that is bewildering in splendor. Among these numerous lakes, one stands pre-eminent—Lake Chelan which lies a short distance north of the main line of the Great Northern in Washington. The lake occupies one of the deepest, if not the deepest, canons on the earth. Granite walls rise above it almost vertically to a height of six thousand or more feet above the waters edge. With the depth of the lake which is over two thousand feet there is altogether a hole in the earth over one and one-half miles in depth. Much of the country in this remarkable region has not yet been explored.

In closing this brief sketch we may add that the crowning pleasure of such an excursion is the marked degree of elegance and comfort with which it may be made on the Great Northern. The equipment seems to be completely new throughout. The cars are unusually strong, with heavy steel sills running the entire length ot the car, which gives them great strength, at the same time making resilient and easy riding. In brief, the Oriental Limited has all the luxuries of life in a grand hotel, with a passing panorama of all that is marvellous in the wonderland of the new and expansive Western world.

General Correspondence

Balancing a Locomotive.

Editor:

In the art of putting an engine on the turntable, first there were the round-house men or inside hostlers—men who are accustomed to move an engine a distance of half the diameter of a driving wheel without air or any other kind of brake except steam in the cylinders. Slow and sure in every movement. It is instilled into them to be careful, handling engines in crowded quarters, with men anywhere and everywhere in the darkness and in clouds of steam.

Here comes one with an engine to be turned; foot by foot he moves onto the table, inch by inch, until one thinks he has not enough steam to get into the house, but is running on "water pressure" which some of them claim they are almost able to do. The end of the table comes up, the engine stops; it is a perfect balance.

There was one of the hostlers who would not put his engine in the center, but always let one end overhang; then the wipers had to get bars and pry the table around, inch by inch, sometimes but a quarter of an inch at a time.

He always liked to have a certain hostler bring his engine in; there was a standing order that no engine was to be brought in over the outgoing track, but he always used it to get his engine in the house, because there would be other engines ahead of him on the incoming track. There was always a fearful ringing of the bell and whistle tooting, and down from the ash pit he would come onto the turntable, as though he was going through the house. At the right fraction of a second he would apply the air brake, the table would oscillate a few times and stop with both ends off the ground, and he would be looking out of the cab window with a funny grin, as much as to say "Well, what do you think of that?"

It was painful to see some engineers try to balance their engines. "Slack back a little, slack ahead a little, just a little back, little more, hold her, no, too far, just a little ahead," and then do it all over again. They actually get pale, with a distressed look upon their faces, and half the time give it up and the engines must then be pushed around, with one end of the table resting on the rail.

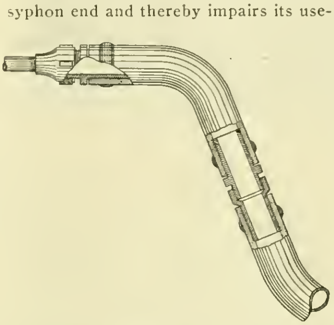
Joseph Anthony.

Oxnard, Cal.

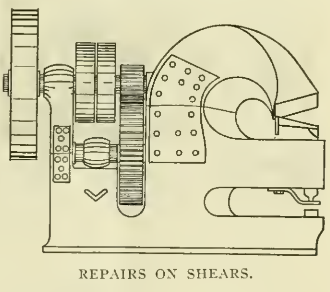
Repairing Hose and Shears.

Editor:

It is a very common accident in engine shop work that the three-inch rubber hose, by reason of the strenuous work to which it is subjected, sometimes in difficult positions, in locomotive washouts, gets a kink on the syphon end and thereby impairs its usefulness, or necessarily becomes shorter and unfit for use at required distances. The accompanying drawing shows a special home-made coupling joint whereby a piece of old hose may be readily annexed, and in the event of that failing at any time another piece may be exchanged, and so on, the good part of the hose being protected until the incidental wear and tear has worn out the entire hose.



REPAIR ON HOSE.



REPAIRS ON SHEARS.

The other drawing shows a quick and completely successful repair on a belt-driven shears which are engaged here on general engine house work. One morning we discovered the shears had sustained a double fracture as shown. Not only would a new machine have cost a good deal, but the delay in transfering the work in the meantime would have been considerable, so a repair was attempted, and steel plates ¾ in. in thickness were cut and fitted and riveted through the castings with straps ½ in. in thickness on the back of the casting attached with stud bolts. The shears are in daily use the same as if nothing had happened.

J. G. Koppell.

Montreal, Canada.

Air Brake Defects.

Editor:

It is now some long time since I have had the opportunity to write anything for your valuable journal, but having a few minutes to spare I wish to say a few words to your many readers on a subject that is of vital interest, particularly to the locomotive engineers, whose duty it is to handle the long trains, in freight service, on the many railroads in all parts of the country.

The much mooted question of undesired quick action of the brakes, and some of the causes leading up to them. As a usual thing, when the brakes have taken quick action, whether it is or is not the fault of the engineer handling the brake valve, he is frequently blamed for it, nevertheless, by many, among which are those who have some knowledge of air brake handling, and those who have none. The fact that the engineer was handling the brake valve at the time undersired quick action developed, leaves him liable to the censure of many, whether they realize the difficult problem of air brake handling or not. Many a good air brake manipulator has been censured wrongfully for damaging equipment when the trouble was entirely beyond his control. There are many men in this class, and for some reason or other, they have no means of defending themselves when wrongfully accused, consequently, they are at the mercy of the accuser, whether the accuser is familiar with what caused the trouble or not. There is no valid reason that men who are thus blamed for poor handling of the brake valve should not familiarize themselves with a few of the plain causes that bring them within the pale of censure.

What is it that causes undesired quick action of the brakes when but a service was expected? Here's the answer, and it will hold good in many of the cases that men come in contact with in their daily work. An engineer, anticipating a brake pipe reduction preparatory to bringing his train to a stop, moves the brake valve rotary from the running position to lap and leaves it there for a short period of time, and when in his judgment

he has reached his "mark," the spot where he usually makes the reduction, he moves the rotary to the service position and perhaps 3 or 4 lbs. reduction is made in chamber D, and the brakes throughout the train have very promptly taken "undesired quick action." He is amazed usually at the result and is willing to swear by everything good and great that it was no fault of his. About how much of this undesired quick action is he to blame for? You want a prompt answer and here it is. About 100 per cent. This will require some little explanation in order to prove the assertion. When this engineer made the terminal test of the brakes on this train before departing from the terminal, he should have taken note of the brake pipe leakage, but he did not. The leakage was no doubt 9 to 12 lbs. per minute. And right there was the cause. When the rotary valve was placed "on lap" the air supply from the main reservoir was cut off from entering the brake pipe and the slow, sure, and certain leakage from the brake pipe developed a differential between itself and the auxiliary pressures, and when the preliminary exhaust port of the brake valve was placed in communication with chamber D, and "outside" the pressure in the auxiliary being considerably stronger than that remaining in brake pipe, the slide valve in the triple was a bit "gummy" or "sluggish" perhaps, and held to its seat while all this difference in pressures was developing, and as soon as there were 2 or 3 lbs. reduction made in the ordinary service position of the brake valve, it started to move; and as the standing friction is always greater than the sliding friction, the greater auxiliary pressure against the triple piston, forced it hard against the graduating stem and spring, compressing it, and when this takes place, the removed corner of the slide valve is over piston and the result is "emergency of the brakes." This is the so-called "undesired quick action." That's where the 100 per cent. to blame comes in for the man handling the brake valve. Could this engineer have prevented this case? Let's see about that. He certainly could, in this way. Referring back to the terminal test, part of this proposition, when he made this test he should have taken his watch out and held it on the brake pipe leakage, while the brake was set to note about how many pounds per minute it registered. This amount of leakage he should have remembered to guide him in handling this brake. He should not have "loafed on lap" with the rotary, anticipating a reduction of brake pipe pressure, but instead, should have moved the rotary valve direct from the running to the service position, while the pressures were equal in the brake pipe and auxiliary, and not have allowed the brake pipe leakage to create the "differential" referred to, and thus have avoided the so-called "undesired quick action" of the brakes on that train. That's the 100 per cent part of this trouble!

The engineer was perfectly innocent of this condition, as has been demonstrated in some cases, to the knowledge of the writer.

Here's another one that gets good air brake manipulators into trouble sometimes. Wearing the shield of innocence on its brow. The "sluggish feed valve." If this valve is sluggish and won't open promptly and supply the brake pipe leakage, no matter—in a great many instances —the differential will again develop, as in the former case, and when the rotary is moved from the running to the service position, we again have "undesired quick action." Is the engineer to blame for this? Well, not exactly. He should, however, have known the condition of the feed valve by making a test. I'll give a little suggestion just how to arrive at a good road method of making a test of a feed valve. If there is any doubt in the mind of the engineer that the feed valve is not as sensitive as it should be, then he should not continue on in his trip until he has satisfied himself as to its true condition. There is no valid excuse for having repeated cases of "undesired quick action" from a sluggish feed valve on the road. It is advantageous to make a test of this and if possible remove the cause. In doing so the possible damage to equipment may be avoided, to say nothing of prevention of possible personal injury to employees on the rear of the train, when the slack is brought up hard due to emergency of the brakes. Should trouble, such as we have mentioned, occur on the road, then make the test. Close the angle cock at rear of tender and on forward end of the head car, then open the angle cock on rear of tender sufficient to create about a 7 to 10 lbs. brake pipe leakage, get up in the cab and place the rotary on lap and note whether the brake pipe indicator on the air gauge will rise and fall to the extent of from 1½ to 2 lbs. If it don't, and probably it won't, then you have the proverbial "sluggish feed valve."

Then the effort should be made to locate, and, if possible, remove the cause. It's but the work of a few minutes to reach the seat of the trouble. Go at it this way. Close the cut out cock under the brake valve, place the rotary in the service position and remove the cap nut from over the feed valve piston and take it out and carefully examine it for "gummy residue" and so on. Clean the parts with a little head-light oil and wipe dry and replace. If the parts were acting poorly on account of the accumulation of foreign matter, and it has, in the cleaning, been removed, then there should be no more trouble experienced for some considerable time from this feed valve. After the parts have been placed back into their proper position and a further test made, which under all circumstances should be the case, then if the brake pipe indicator doesn't fluctuate to the 1½ to 2 lbs. from the 7 to 10 lbs. leakage, as in the former case, then the feed valve piston is too loose a fit in its cylinder and renders this feed valve unfit for road service.

There are some other items that give rise to "undesired quick action of the brakes," but owing to the fact that if they were explained here they would take up too much space in the journal, we will send them in for another issue of this valuable journal, at a later date.

Jas. Spellen,
Road Foreman of Engines,
B. R. & P. R. R., DuBoise, Pa.

EIGHT-WHEEL LOCOMOTIVE, "FRANK HEBE," ERIE RAILROAD.

A Typical Veteran Engineer.

Editor:

Enclosed is a photograph of the locomotive that I have been running on the Erie for the last two years, between Elmira and Blossburg. You will note Fireman S. Powell in the cab, and the undersigned on the ground near the cab, and the fire-cleaner in the gangway. I have been employed on the road forty-five years, and began as a brakeman in 1867, on the Tioga railroad, now a part of the

Erie system. Two years later I was firing a Norris hook motion engine, and four years later was promoted to engineer and have continued in that capacity ever since. I have been in the Order of the Red Spot ever since it was established by Superintendent Parsons, and, as you will note on the cab, the Erie has further honored me by placing my name on the engine. I have been a member of the Brotherhood of Locomotive Engineers since 1883, and am now attached to Division 641, Hornell, N. Y.

Railway and Locomotive Engineering has been my standard educational publication since it started. I have learned more from its pages than all other sources put together.

Frank Hebe.

Elmira, N. Y.

Trans-Cibirian R. R. Double-Tracking Progress.

Cibiria ("Siberia") is the land of the greatest number of great waterways in this world; and the building of Russia's trans-Asiatic railroad involved the construction of many types of bridges, big and small. Russian engineers got their *мост* (Russ for bridge) ideas from the rest of the world, as the Russian engineering brain is not a creative one; it apes almost everything, and is content to ape. The illustrating mat-

TESTING THE BRIDGE OVER THE RIVER TAU, SIBERIA.

ter herewith proves that. There are numbers of parabolic or bow-truss bridges along the trans-Cibirian—all mere copies of western Europe designs, without a suggestion of diversity, or even "crankism"—because the average Russian mind is not even inventive enough to develop the "crank." The under-form of bow bridge was invariably followed, because cheaper to construct than the super-bow, involving the setting-up of less than half of false-structure work or scaffolding; but, per contra, the engineer has "little to

UNDERBOW BRIDGE ON THE YCHAIKI RIVER, TOMCK, SIBERIA.

show" for his work; and a fine specimen of bridge-mechanics—one of his prides—is for ever "lost," so to speak, under the feet of the casual observer, and only his fellow-engineers can appreciate his work. Further, the underbow may prove a serious obstacle in the event of subsequent deepening of a stream to render it navigable for even minor craft.

Stone-work on the bridges was mostly done by Italian contract labor imported from Garibaldi-land; the iron work was all Russian, and erected by Russian mechanics—mostly from Mockba, central Pocia. For the big 5- to 8-span truss bridges, bridge-works were erected in situ, and the spans built therein, and one after another rolled into place. The old Howe truss was favored by some contractors. The cantilever is not known anywhere in the vast railroad systems of the Russian union, nor the suspension. In fact, divers of the engineers asked what was meant by cantilever. I told them; also of the ancientness of the word—derived from Arabik *kantará,* meaning bridge. In España there is an ancient Arab-named city called Alkantara (lit., The bridge), the place being named after the old bridge of the town, which still exists from Arab times. The dictionary-given origins of "cantilever" are wrong. Those were the days when Iberia was in its palmiest, and held her own among the nations. With the defeat and final expulsion of Arab power and learning, commenced the decline of old Spain through the centuries to its present degradation under the semi-imbecilic *bujaron* "Alfonso Hapsburg" (real name unknown). However, in the future Repúblika de España, there may be some hope! All this the skrivener noted for himself during trips to Hesperia years ago.

But to re-switch to Cibiria! (That is the correct spelling—from Russian, Cibipia.) In the picture matter, we see comparative features; i.e., rolling-stock en route, which gives a good idea of bridge dimensions; and prices ranged from 50,000 to 3 million *pybli* (pronounced rubli), or say $25,000 to $1,500,000. The great bridge over the Enecei cost that, but will be eclipsed by that building over the Amur.

* * * *

The double-tracking of the trans-Cibirian railroad proceeds apace, and renews attention to that part of the globe. Doubling a 5,000-mile railroad between the Ural range and the Pacific ocean, is an enormous work; and the Russian administration has been pro-

gressing with the work quietly, and—to the credit of the nation, be it written—wholly with Russian-made material and Russian workers. During the Japo-Russia war of over a half-dozen years ago, the Tolstoi-landers found themselves most seriously handicapped by a single track—the many delays to troop-trains waiting for line-clear schedules being such, it took some six weeks getting soldiers across Cibiria to Manchuria; whereas a double-tracked route would have afforded transit in a fortnight.

Further, the miseries to the conscripts during the train journey for seven months of the rigorous Cibirian winter were such that almost half the unfortunates were invalided ere reaching "the front." With some trainloads, in mid-winter, it was a daily lugubrious task of the train-crew to go among the huddled-together soldiers, picking out the frozen-to-death "stiffs," and laying them out like logs of wood at wayside stations, to be buried later by the station help. In their desperation to keep warm in their dark box-cars, caged and securely locked-in to prevent escape, without stoves, they would burn any bits of rags or wood-chips or rubbish they could get hold of, on the bare car-floor, and thrust into the flames the stock-ends of the rifles of the "stiffs" who had been ejected. Many even of the living poked in their own rifle-butts to burn, although well knowing the seriousness of the offense in the eyes of the Russian military thugokracy; but they soliloquized: "Here!—might as well be shot to death as freeze to death." As the car-floor itself began to smoulder and burn, the fire would be shoved away in a heap about a foot; a soldier or two would at once stand on the vacated spot both to stop the burning and to get some warmth into their dead-with-the-cold toes. This, of course, meant early ruination to their all-essential footwear. Thus the heating makeshift would go on, until the whole floor of the car was almost covered with black-charred patches.

Naturally, this forced heating led to all sorts of mishaps. As there was no ventilation, the smoke had to escape through the crevices; numbers of soldiers were asphyxiated—especially at night—cases of fire were frequent, and some cars were bodily burned up, with their living freight trapped in beyond rescue, on a howling arctic-blizzard night on the vast Cibirian glacial wastes, with the engine proceeding at an 8 or 10-mile gait, due to the difficulty of maintaining steam. Even halting the train 'tween stations (maybe two-score miles apart), and trying a rescue, availed little, as to tumble out into 40 below zero meant taking chances of speedily becoming transfixed into a "stiff." Besides, there was scant room in the other already crowded box-cars to cram the burned-out conscripts—or those who managed to get out with their lives. Cases occurred of trains pulling in to a lone station of an icy-cold morn, with the rear half of what-had-been box-cars burned down to their blackened wheel-frames. A sorry spectacle!—and a sorrier tale along the track for a score miles out—with its strewing here and there of charred human remains as they had trounced off or through the burning-away box-car platforms!

The present writer had a couple of winters' experiences of travel in Russian Asia, and can imagine the sufferings of the unfortunate conscripts of the Russian thugokracy.

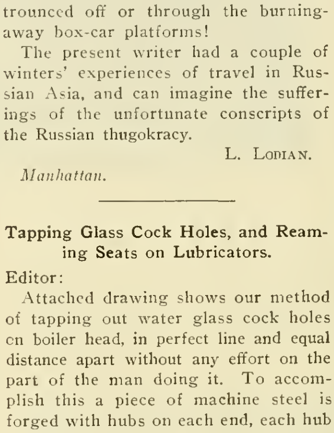
L. Lodian.

Manhattan.

Tapping Glass Cock Holes, and Reaming Seats on Lubricators.

Editor:

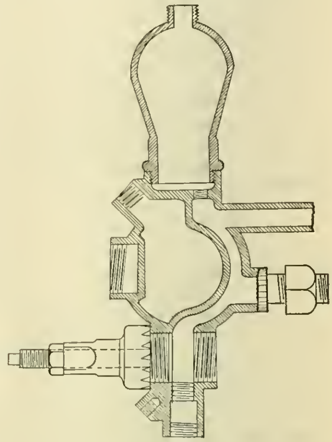
Attached drawing shows our method of tapping out water glass cock holes on boiler head, in perfect line and equal distance apart without any effort on the part of the man doing it. To accomplish this a piece of machine steel is forged with hubs on each end, each hub is bored out square with each other and steel bushings pressed in and bored out



TAPPING GLASS COCK HOLES.

to fit the shank of tap which guides them in perfect line when tapping the sheet. It can be made any distance between centers, ours being 12 ins. The old and unsatisfactory method of tapping out these holes would be a thing of the past if this jig method was generally adopted.

The other print shows a method of facing or reaming seats on bull eye lubricators, which method is quickly and accurately done by hand without removing the lubricator from boiler head. You will note that steel plug is



REAMING SEATS ON LUBRICATORS.

made with thread on end that fits oil or feed opening in lubricator, and its body part is ⅝ in. round, which fits hole in reamer, which reamer is fed to its work by nut on end of stem. A few turns of the reamer will put the seat in perfect line and as good as original.

Chas. Markel,
Shop Foreman,
C. & N. W. Ry.

Clinton, Iowa.

Re-use of Oil.

An important phase in oil and manufacturing economy, when the character of machinery renders possible the necessary equipment, is the re-use of oil. To re-use oil it must necessarily have all impurities that will cause damage removed, else the re-use will result in actual loss. In many plants the oil used is caught and again used on rough work, where the impurities will do no appreciable damage.

In modern practice the so-called "sufficient" lubrication is no longer considered adequate; flooded journals are demanded and the highest economy requires the re-use of oil. No half way provision is tenable, and if oil is to be re-used, there is no object whatever in restricting its use. Oil losses are due to destructive distillation at the journal. A greater quantity of oil produces less friction, therefore less heat and less distillation loss. The friction losses are governed to a very large extent by the quantity fed. The re-use of oil has been successful on automobiles, and there is no reason why the method should not be used on heavier machinery.

Old-Time Railroad Reminiscences.

By S. J. Kidder.

In these days of effort on the part of railroads to economize in the use of oil and fuel, the writer's thoughts often wander back to his early years as a locomotive engineer in the "wild and woolly west," as it was then generally known, when even at that somewhat remote period the subject of economy in the use of these supplies was being agitated by railroad officers.

On the old "B. & M. R. in Iowa," later becoming a parcel of the C. B. & Q., efforts were being made to reduce the oil and fuel bills and in some respects a decided economy was realized; in others the reverse was evident, apparently with the connivance of officials who, while supposedly intent on carrying out economic measures, opposed or hindered proven methods of making such practicable.

Prior to the time these economies were introduced, with the average engineer the question of saving oil was not considered, the general practice being to lubricate his engine both frequently and liberally. The snout of the quart oil cans were provided with a very generous exhaust nozzle from which the oil holes, pockets and uncapped oil cups could be quickly filled to overflowing, in numerous instances the greater quantity of the lubricant flowing in a gentle stream to the ground below and by the time the engine was well under way most of the contents of the oiled filled receptacles had been distributed from one end of the engine to the other. To a considerable extent this state of affairs prevailed on the B. & M. until in 1872 an order was issued to the effect that engineers would be expected to make 15 miles to the pint, this including engine, valve and illuminating oils.

It might be said in passing that these lubricants did not possess the degree of "refinement of that now supplied by the Galena Oil Co., the engine oil being of the crude West Virginia variety and tallow, often of a quality to pit the valves and seats, was furnished for steam chests and cylinders.

The ink on the bulletin notice had hardly become dry when it came to the attention of the writer and he immediately took action by procuring, at his own expense, a highly polished brass squirt can which, while being an oil saver also comported favorably with the embellished trimmings on the boiler head.

Similar action was taken by the other engineers and active efforts were at once instituted by all to get within the 15 mile limit. This, as later monthly statements indicated, was generally accomplished, but as month after month went by and Nelse Best proved in a class by himself, with an average of more than 30 miles to the pint, the other engineers marveled as Nelse had never before exhibited an aptitude of doing things superior to his fellows.

Efforts were made to ascertain how he could discount them, as in oiling he appeared to use the fluid as freely as others, until finally it was discovered that Nelse was playing fast and loose with the blackstrap barrel in a "car wheel whacker's" shanty, convenient to the coal shed in Chariton, from which he frequently replenished a two gallon can.

When caught in the act he shamefully capitulated, dumped the oil he had just purloined on the ground and from that time on his oil record was on a parity with that of the others. In time, however, this oil economy by a sort of gradual process of elimination fell into innocuous desuetude and for some years little or no attention was paid to it, then it was revived again. At the time I was enjoying a vacation, but upon my return to work saw a bulletin notice to the effect that engineers would hereafter be allowed five pints of engine oil per round trip, 150 miles.

That afternoon while visiting the shops to see how the 245, then in for an overhauling, was coming along, I dropped into the master mechanic's office. He looked up, passed the time of day, then remarked, "Well, K—, I have you right where I want you now."

"How is that?" said I.

"Hereafter you chaps get only five pints of oil for a round trip."

"Is that so? Well, Mr. West, for several years I have been making it on three or less and guess I can pull through a while longer on five," whereupon he turned to his desk and resumed writing. In the early seventies automatic oil cups for steam chests were being placed on the market but were not looked upon with much favor for the reason that they appeared to be a sort of mysterious device "that you couldn't tell whether they were feeding or not." In 1873 a sample set of Nathan & Dreyfus automatic oil cups were placed on the steam chests of the "Autocrat," Harry Ball's engine, he being the oldest engineer in point of service on the division. A few days later I inquired about the cups and Harry, in language more forcible than eloquent, registered his opinion of such cups and newfangled things in general, ending by saying he had removed the tubes and the fireman was again oiling by hand.

"Why did you remove the tubes," I inquired.

"Well," he replied, "I don't want no hermetically sealed oil traps on my engine. When grease is poured into the steam chests I want to know that it goes there." I had sufficient knowledge of the construction of these cups to lead me to believe they were a good thing and immediately opened negotiations with Harry with a view of obtaining them. The result was that if I would remove and replace them with the hand oil cups on my engine, the "Winona," I was welcome to them. This I did and after a little experimenting in the way of adjustment found them very superior to the old cups inasmuch as the valves received lubrication when working steam, their value being particularly noticeable when working the engine hard in ascending long hills, as well as the additional quantity carried to the valves and cylinders at the time of shutting off. Not long after trading for the cups Harry took a ride with me and regardless of all I could say, he would not be convinced of their merits.

Said I, "Tonight, when I get out of the roundhouse, we will give the valves a hand oiling and run to Afton with the lubricators closed and while ascending the grade into that town you can 'hook her up.'" With one foot against the boiler head it took all of Harry's strength to get the reverse lever up to the six inch notch. At Afton, I opened up the cups and six miles beyond, when nearing the summit of Grand river grade, with throttle wide open and the lever in the 14 inch notch, he again braced against the boiler head, gave a violent jerk, pulling the lever past the center of the quadrant and an instant later the lever shot into the corner, Harry at the same time going against the boiler head as if shot from a catapult. After gathering himself he somewhat cautiously mounted the fireman's seat and if he still questioned the efficacy of an hermetically sealed cup, feeding oil into the steam chest, he never mentioned it to me.

These cups soon became the standard, all engines being provided with them, though several years later were discarded, not because of any fault with them, but rather, from negligence on the part of many of the men in keeping them in proper adjustment to feed only the amount of oil required or failure to give them the little needed care they demanded.

(*To be continued.*)

Danish Locomotive Building.

In consequence of a general desire throughout Denmark that the country should as far as possible be independent of foreign-made machinery, pressure has been put upon Parliament to encourage the construction of locomotives at home instead of importing them from foreign countries. The result is that the Danish State Railways Administration, which previously ordered its locomotives from abroad, has just ordered three from the Frichs Company at Aarhus. These engines will be of a small type, for switching purposes, but the company have arranged to build new large locomotive works with the object of constructing not only large locomotives, but also many other kinds of railway material. The Dane has not been particularly active in adopting improvements in transportation, but it is evident that he is waking up.

What Is Heat?

Science has been defined as "accumulated and established knowledge." The sciences which deal with heat come to rather perplexing conclusions as to what heat really is. In the days of long ago, heat was called caloric and was supposed to be a subtle fluid that entered into substances with the sensation of heating. Ancient philosophers discredited the theory that heat was a natural entity, but their opinions were overruled by practical men for many centuries.

About one century ago, Benjamin Thompson, an American engineer, while in the employ of the King of Bavaria, observing the heat generated from the boring of cannon, concluded that heat is a mode of motion and that by a given amount of mechanical work a définite amount of mechanical heat would be produced. Other scientists pursued the question and its demonstration became for years a favorite line of experiment by physicists. Mayer suggested the identity of heat and energy and the interchangeability of heat and motive power; Joule proved by a long series of experiments, that the production of heat was attended by the disappearance of a definite amount of mechanical energy; while Tyndall proved it to be a mode of motion, coming to the same conclusions as were reached by Thompson.

The work described we would conclude to be established knowledge, but now comes no less a personage than Professor Callendar, president of the British Association, who insists that the old caloric theory is correct. He assures the world that what we have been calling heat, measuring as heat, is merely the energy of heat. The heat itself may well be a substance that carries the energy, somewhat as a stream of water carries the energy that enables it to turn a mill-wheel. After the wheel is passed the water has lost some of its energy, but the water itself has not disappeared. Says Professor Callendar (to quote from the text of his address printed in *Science*, New York):

"The caloric theory is generally represented as being fundamentally opposed to the kinetic theory and to the law of the conservation of energy. I would first remark at the outset that this is not necessarily the case, provided that the theory is rightly interpreted and applied in accordance with experiment. Mistakes have been made on both theories, but the method commonly adopted of selecting all the mistakes made in the application of the caloric theory and contrasting them with the correct deductions from the kinetic theory has created an erroneous impression that there is something fundamentally wrong about the caloric theory, and that it is in the nature of things incapable of correctly representing the facts. I shall endeavor to show that this fictitious antagonism between the two theories is without real foundation. They should rather be regarded as different ways of describing the same phenomena. Neither is complete without the other. The kinetic theory is generally preferable for elementary exposition, and has come to be almost exclusively adopted for this purpose; but in many cases the caloric theory would have the advantage of emphasizing at the outset the importance of fundamental facts which are too often obscured in the prevailing method of treatment."

Professor Callendar insists that such common statements as the one that "heat is a form of energy and not a material fluid" are based on misconceptions. He says:

"The experimental fact underlying this statement is that our ordinary methods of measuring quantities of heat in reality measure quantities of thermal energy. When two substances at different temperatures are mixt, the quantity remaining constant—provided that due allowance is made for external work done and for external loss of heat—is the total quantity of energy. Heat is a form of energy merely because the thing we measure and call heat is really a quantity of energy. . . . .

"The term *heat* has become so closely associated with the energy measure that it is necessary to employ a different term, *caloric*, to denote the simple measure of a quantity of heat as opposed to a quantity of heat energy. The measurement of heat as caloric is precisely analogous to the measure of electricity as a quantity of electric fluid. In the case of electricity, the quantity measure is more familiar than the energy measure, because it is generally simpler to measure electricity by its chemical and magnetic effects as a quantity of fluid than as a quantity of energy."

"Energy so far as we know must always be associated with something of a material nature acting as carrier, and there is no reason to believe that heat energy is an exception to this rule. The tendency of the kinetic theory has always been to regard entropy as a purely abstract mathematical function, relating to the distribution of the energy, but having no physical existence. . . . In a similar way, some twenty years ago the view was commonly held that electric phenomena were due merely to strains in the ether, and that the electric fluids had no existence except as a convenient means of mathematical expression. Recent discoveries have enabled us to form a more concrete conception of a charge of electricity, which has proved invaluable as a guide to research. Perhaps it is not too much to hope that it may be possible to attach a similar conception with advantage to caloric as the measure of a quantity of heat."

"Many other objections have been felt rather than explicitly stated, and are therefore the more difficult to answer satisfactorily. Others arise from the difficulty of attaching any concrete conception of a quantity of something to such a vague and shadowy mathematical function as entropy. The answer to the question 'What is caloric?' must necessarily be of a somewhat speculative nature. But it is so necessary for the experimentalist to reason by analogy from the seen to the unseen that almost any answer, however crude, is better than none at all. . . . .

"Without insisting too much on the exact details of the process, we may at least assert with some confidence that the corpuscles of caloric which constitute a current of heat in a metal are very closely related to the corpuscles of electricity, and have an equal right to be regarded as constituting a material fluid possessing an objective physical existence.

"If I may be allowed to speculate a little on my own account (as we are all here together in holiday mood, and you will not take anything I may say too seriously), I should prefer to regard the molecules of caloric, not as being identical with the corpuscles of negative electricity, but as being neutral doublets formed by the union of a positive and negative corpuscle, in much the same way as a molecule of hydrogen is formed by the union of two atoms. Nothing smaller than a hydrogen atom has yet, so far as I know, been discovered with a positive charge. This may be merely a consequence of the limitations of our experimental methods."

"When we speak of caloric as being generated, what we really mean is that it becomes associated with a material body in such a way that we can observe and measure its quantity by the change of state produced. The caloric may have existed previously in a form in which its presence could not be detected. In the light of recent discoveries we might suppose the caloric generated to arise from the disintegration of the atoms of matter. No doubt some caloric is produced in this way, but those corpuscles that are so strongly held as to be incapable of detection by ordinary physical methods require intense shocks to dislodge them. A more probable source of caloric is the ether, which, so far as we know, may consist entirely of neutral corpuscles of caloric."

The president of the Northern Pacific announced that construction work is actively under way on the Point Defiance line, which will run from Tacoma to Tenina, Wash., taking the place of the present high grade route between these towns. The maximum grade on the new line, which follows the shore of Puget Sound, will be 16 ft. to the mile.

This is only one of the many extensive improvements that are partly contemplated, and some of which are already in an advanced state of progress.

Mikado Type of Locomotives for the Woodward Iron Company

Considerable interest is being taken in a Mikado type of locomotive which has just been completed by the Baldwin Locomotive Works for the Woodward Iron Company, Alabama. The service requirements are unusual as is frequently the case on industrial and private railways, so that special locomotives must be designed to meet the conditions successfully. In this instance the locomotive is employed in hauling loaded coal trains from the company's mines to the furnaces at Woodward. The rolling stock is composed principally of cars of 70-tons capacity. On the main line, the maximum grade is of one per cent., seven miles in length; while at the mines there are grades of 3 per cent. and uncompensated curves of 16 degrees. The track conditions are excellent for a road of this character, and heavy wheel loads can be safely carried.

The locomotive illustrated uses saturated steam, and develops a tractive force of 55,000 pounds. The total heating surface is 6,036 square feet, so that for each square foot there is developed a tractive force of 9.1 pounds. Based on the steaming capacity in proportion to the tractive force developed, this is an unusually powerful boiler for a Mikado type locomotive. The large heating surface has been secured without crowding the tubes or restricting circulation, as the mud ring is 5 inches wide all around and the tubes are spaced with ¾-inch bridges.

The steam distribution is controlled by balanced slide valves, which are driven by Walschaerts gear and are set with a lead of ¼ inch. The frame construction at the cylinders is unusually strong. The front rails are single, and are cast in one piece with the main frames. The front deck plate is extended back under the cylinder saddle, and this extension bears against the inside faces of the frames and takes the cylinder bolts. Just back of the cylinders is a cast steel brace which extends the full depth of the front driving pedestals. This brace carries the radius bar pin for the forward engine truck, and also acts as a fulcrum for the driving brake shaft. Back of the rear driving wheels is a somewhat similar brace, arranged to take the radius bar pin for the back engine truck. To this brace is secured an expansion plate which supports the front end of the fire box. A similar plate supports the furnace at the back.

The equipment of this locomotive includes pilots and electric headlights at each end. Two sand-boxes are provided, and flange lubricators are used on the front and rear driving-wheels. Special attention has been given to the cab arrangement, which because of the service requirements is a matter of particular importance. The Ragonnet power reverse gear is applied, with a steam connection for emergency use. This device has proved exceedingly reliable in service, and it greatly reduces the amount of labor required in handling the engine.

The principal dimensions of this locomotive, as given in the table, indicate its size and capacity. It is admirably designed for heavy duty, and may be expected to give a good account of itself in service.

Gauge, 4 ft. 8½ins.; cylinders, 24½ ins. x 30 ins.; valves, balanced slide.

Boiler—Type, straight; material, steel; diameter, 86 ins.; thickness of sheets, ⅞ ins.; working pressure, 200 lbs.; fuel, soft coal; staying, radial.

Firebox—Material, steel; length, 120 ins.; width, 90 ins.; depth, front, 86¼ ins.; depth, back, 72¼ ins.; thickness of sheets, sides, ⅜ ins.; back, ⅜ ins.; crown ⅜ ins.; tube, ½ ins.

Water Space—Front, 5 ins.; sides, 5 ins.; back, 5 ins.

Tubes—Material, steel; thickness, No. 12 W. G.; number, 470; diameter, 2¼ ins.; length, 21 ft., 0 ins.

Heating Surface—Firebox, 245 sq. ft.; tubes, 5791 sq. ft.; total, 6036 sq. ft.; grate area, 75 sq. ft.

Driving wheels—Diameter, outside, 55 ins.; center, 48 ins.; journals, main, 10½ ins. x 13 ins.; others, 9½ ins. x 13 ins.

Engine Truck Wheels—Diameter front, 30 ins.; journals, 6 ins. x 10 ins.; diameter, back, 36 ins.; journals, 8 ins. x 14 ins.

Wheel Base—Driving, 16ft., 0 ins.; rigid, 16 ft., 0 ins.; total engine, 35 ft., 2 ins.; total engine and tender, 67 ft., 1 in.

Weight, Estimated—On driving wheels, 220,000 lbs.; on truck, front, 25,000 lbs.; on truck, back, 40,000 lbs.; total engine, 285,000 lbs.; total engine and tender, 440,000 lbs.

Tender—Wheels, number, 8; diameter, 33 ins.; journals, 5½ ins. x 10 ins.; tank capacity, 8,000 gals.; fuel capacity, 14 tons.

2-8-2 TYPE OF LOCOMOTIVE FOR THE WOODWARD IRON COMPANY, ALABAMA.
Baldwin Locomotive Works, Builders.

Where a railroad accident happens now-a-days in which wooden cars collapse it has become the fashion to demand that laws be enacted prohibiting the use of wooden cars on steam railroads. The steel car is making its way fast enough.

Catechism of Railroad Operation

Questions and Answers.

Second Series.

The Mallet Articulated Locomotive.

By F. P. Roesch.

(*Continued from page 404.*)

Q. How would you test for a stuck or broken by-pass valve?

A. Place the engine on either top or bottom quarter on the side to be tested. Now place reverse lever first in either full gear forward or full gear back; and, with the Baldwin type of locomotive, open the starting valve. With the American type of locomotive, open the main throttle. This will admit steam to one end of the low pressure cylinder. If the by-pass valve at that end is either stuck or broken, it will allow part of the steam to pass through the by-pass valve into the other end of the cylinder; from thence through the exhaust port and out of the stack, causing a blow similar to broken cylinder packing or broken valve seat. It can also be determined, when running, by a blow occurring between exhausts; as, for instance, if but one of the by-pass valves was stuck-up or broken, you would have three normal exhausts at the stack and one blow. If both by-pass valves on one side were stuck-up or broken, however, there would be a continuous blow at the stack. The broken valve can be located by testing as above; and when the engine is placed in the position where the blow occurs, place the reverse lever in the opposite corner. If the blow stops, it will indicate that the defective valve is at that end of the cylinder that was in communication with the steam chest pressure through the ports, when the lever was in its first position; as, for instance, say that the test was being made for a defective by-pass valve at the right low pressure cylinder, and the locomotive was spotted with the main crank pin upon the upper quarter. Now, if the blow occurs with the reverse lever in the forward corner but not in the back corner, it is evident that the back by-pass valve on that side is either stuck or broken.

Q. How would you proceed in the case of a stuck or broken by-pass valve?

A. After locating the defective valve, take off the valve cap, remove the valve, and if it was simply stuck, clean it off thoroughly; oil it with headlight oil, and replace it. If the valve is broken, and broken in such a manner that it will still make a seat if blocked down, block it in place, holding it with the valve chamber cap. If it is so broken, however, that it can not seat, either slip a blind gasket between the by-pass valve chamber and the port communicating to the steam port; or, with some types of by-pass valves, slip a blind gasket into the connecting steam pipe.

Q. Will a Mallet compound locomotive burn more coal than a simple locomotive having the same amount of grate area? Why?

A. No. In fact, it will not burn as much coal; as, owing to the steam being compounded, the exhaust and, consequently, the draft on the fire is much lighter.

Q. What is the object in building this type of locomotive?

A. To obtain more adhesive power, as the tractive power of a locomotive is governed largely by its adhesion, and the adhesion depends upon the weight upon the drivers; and as the amount of weight permissible on a journal is limited, it is evident that increasing the number of drivers allows a greater weight to be carried, thereby increasing the adhesive power, thus permitting an increase in cylinder power. The articulated feature is necessary in order to reduce the rigid wheel base, and allow the locomotive to take ordinary curves.

Q. How is the additional weight on the drivers obtained?

A. By increasing the length and size of the boiler, using in addition to direct heating surface, feed-water heaters, reheaters, etc., which can all be carried in or made a part of the boiler, the total weight resting on the two engines.

Q. What is a feed-water heater? Where located, and how operated?

A. A feed-water heater is a storage space where the feed-water is heated prior to its being forced into the boiler. It is largely used in connection with this type of locomotive, and is generally located in the forward part of the boiler, ahead of the flues proper. The heat is imparted to the water by the gases from the firebox, after passing through a number of tubes in the feed-water heater before they finally emerge at the stack; the water in the feed-water heater taking up considerable of the heat of the gases passing through it.

Q. Are the feed-water heaters kept full of water at all times? Why?

A. Yes; as the feed-water heater must be filled before any water can be forced into the boiler, the injectors being connected to the heater and not to the boiler proper.

Q. When superheaters are used in connection with this type of locomotives, where are they located, and how operated?

A. In some types of Mallet compound locomotives the superheater consists of what is termed the smoke-tube type, wherein the superheater elements are located in large tubes or flues, extending from the front to the back flue sheets, and the steam, before reaching the high pressure cylinders, is passed through these superheater elements, and there superheated. In other types of locomotives, the superheater consists of a large drum, practically the same size as the boiler proper, and located just ahead of the boiler proper. The drum is filled with tubes, or flues, running parallel with the boiler, so that the hot gases, after passing through the boiler proper, must pass through these flues in the superheater before they can escape to the stack. The steam to be superheated surrounds these flues, and, by means of baffle plates, is compelled to circulate all around these flues before it is finally admitted to the high pressure steam chests. On other types of locomotives, the superheater consists of a series of pipes of small diameter, taking the place of the steam pipes in the front end, the steam obtaining its superheat from the front-end gases. The first type of superheater mentioned is termed the "High degree," the second the "moderate," and the third the "low" degree superheater.

Q. What is a reheater used in connection with this type of locomotive? Where located, and how operated?

A. A reheater is built practically the same as the "moderate" or "low" degree superheater, and can be located either in boiler extension, ahead of the boiler proper, or in the front end. Its purpose is to reheat the exhaust steam from the high pressure cylinders before it passes on to the low pressure cylinders. It operates automatically, and practically the same as a superheater, in that the steam to be reheated obtains its additional heat from the gases passing from the firebox, through or around the reheater elements on their way to the stack.

Q. What would you do in case of a broken low pressure piston or head?

A. Disconnect the valve stem on that side, clamp the valve to cover the ports. In case the piston was broken and the head not punched out, remove the broken parts, if they are liable to interfere or cause more damage, leaving the cylinder

head off. If, after removing the cylinder head, you find that the broken parts can do no further damage, leave the head off and go on. The open end of the cylinder will enable you to keep the piston oiled, and, at the same time, prevent the compression of air.

Q. What would you do in case of a broken high pressure piston or head?

A. Handle the same as for broken low pressure piston or head.

Q. What would you do in case of a broken low pressure cylinder or cylinder head?

A. Disconnect the valve stem at that cylinder, clamp the valve to cover the ports. If the cylinder is so broken that it would not be safe to allow the piston to work up and back in it, it would, of course, be necessary to disconnect the main rod also. If the cylinder is simply cracked, however, remove the cylinder relief valves so that the piston can be kept lubricated through the openings, and compression of air can be relieved through the same openings. If the cylinder head is knocked out, simply disconnect the valve stem and clamp the valve to cover the ports.

Q. What would you do in case of a broken high pressure cylinder or cylinder head?

A. Handle the same as for broken low pressure cylinder or cylinder head.

Q. What are cylinder relief valves? Why used, and where?

A. Cylinder relief valves are valves fashioned similar to the ordinary pope or safety valves; that is, a valve screwed into the end of the cylinder or cylinder head, having a spring that can be adjusted to the tension desired so as to hold the desired amount of pressure in the cylinder, and to raise and relieve any excess pressure. These valves are usually screwed into the lower part of the front and back cylinder heads.

Q. What would you do in case one of the cylinder relief valves blew out?

A. If noticed the moment it blew out, would stop, pick it up and screw it in again. If it could not be found, would endeavor to plug the opening with any kind of a plug available. Frequently one of the compression grease plugs out of one of the rod cups can be used for this purpose. If not, a wooden plug can be used, although these burn out very rapidly.

Q. How would you lubricate the valves and cylinders on a locomotive of this type?

A. If the lubricator is connected to both high and low pressure steam chests, would use about six drops per minute to each high pressure valve, and three drops per minute to each low pressure valve when working steam, reversing the operation when drifting.

Q. What would you do in case of a broken frame on the forward engine?

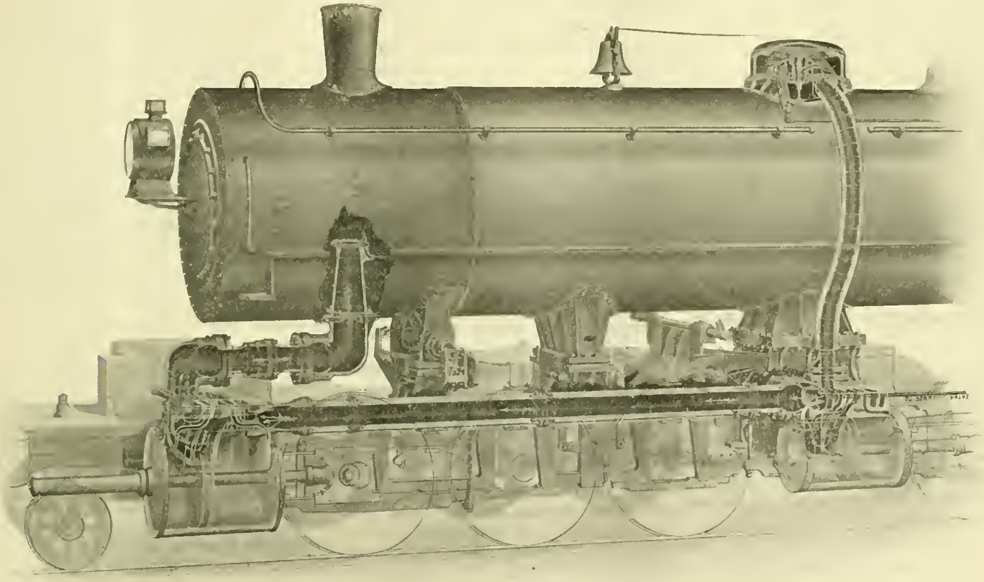
A. If the frame was broken ahead of the main driver and both rails were broken, would disconnect the valve stem on that side, clamp the valve to cover the ports, remove the cylinder relief valves from both ends of that cylinder, and proceed with the three cylinders working. In this case, the engine could only handle three-fourths of its rating. If but one rail of the frame were broken, so that there would not be much danger of further damage, or if but one rail of the frame were broken back of the main drivers, would proceed with the engine as it was. If both rails of one frame were broken between the main and rear drivers, however, would disconnect the back sections of both side rods, and proceed.

Q. What would you do in case of a broken frame on the rear or high pressure engine?

A. If but one rail of the frame were broken, would proceed without disconnecting. If both rails on one side were broken, however, and broken just back of the cylinders so that a pull on the frame would be apt to tear off the guides, etc., would set out the train and go in light If both rails of the frame were broken back of the guide yoke connection, or back of the rear drivers, would disconnect the valve steam on that side, clamp the valve to cover the ports, and go in with one high pressure and two low pressure cylinders working. In this case it would not be advisable to handle more than half a train.

Q. What would you do in case of some defect arising to the valve gear of the low pressure engine?

A. As locomotives of this type are usually equipped with the Walschaerts gear, it would depend upon what broke.



PIPING ARRANGEMENT OF BALDWIN MALLET LOCOMOTIVE.

The breakage, however, could be handled the same as a similar break on a simple engine.

Q. What would you do in case it became necessary to disconnect both low pressure valves? Could the engine be handled under its own steam?

A. With the American type of locomotive there would be no trouble in bringing the engine in under its own steam, as it would simply be necessary to open the separate exhaust valves, and come in with the high pressure engine working. With the Baldwin type it would be rather a difficult matter, however, especially if the locomotive was fitted with the common "D" or slide valve at the low pressure cylinders. If the locomotive was fitted with piston valves, the front valve chamber heads could be removed and the valves pushed forward enough to uncover the back steam port and also part of the exhaust port, so that the exhaust steam escaping from the high pressure cylinders and passing through the receiver to the low pressure steam chest, could find an outlet through the open ports. If the engine was fitted with the "D" or slide valve, however, the only way that the engine could be brought in under its own steam, with both low pressure valves disconnected, unless the valves could be pushed forward enough to uncover the exhaust port, would be to take up both steam chests, remove the balance strips out of the top of the valves; then raise up the valves and block them off their seats with iron blocks or wedges, replacing the steam chest covers. This will allow the steam exhausted from the high pressure cylinders to pass into the low pressure steam chests under the valves, and on out through the exhaust.

Proper Welding.

The following notes on welding practice are from a paper presented by Max Bermann at the Sixth Congress of the International Association for Testing Materials.

The pieces to be welded should be heated in an oxidizing flame. The areas of the surfaces in contact should be as large as possible and the ends should be shaped like wedges fitting into each other. Intimate contact should be effected at all points on both sides of the wedges. When such intimate contact has been provided before heating to welding temperature even a relatively large crust of cinders will not prevent a good weld. The pressure required to bring the two surfaces into good contact should be directed towards the center of the faces. It should only penetrate up to the middle and then be directed toward the marginal zone to eject the slag. The weld will be a practical success when the joint is invisible and does not open when bent to and fro at a red heat. The test of the soundness of a weld by alternating tension or bending at ordinary temperatures should be applied for the passing of weldable steels in acceptance tests. The reagents used for welding steels which are not of themselves weldable, consist of materials which form slag and of iron turnings or thin wires.

Oil Fuel.

We are constantly receiving requests for information regarding the use of oil fuel for locomotive firing, and give below the methods universally recommended for obtaining best results.

The size of the burner must necessarily depend upon the amount of oil to be burned, and this in turn depends upon the heating surface of the engine. About 1½ lbs. of oil per square foot of heating surface per hour is usually sufficient when forcing the engine and about 12 lbs. of water will be evaporated on this basis at 212 degrees F. Taking this 1½ lbs. of oil as a basis and multiplying by the number of square feet of heating surface will give the number of pounds of oil that must be atomized and burned per hour. This affecting the size of burner to be used. It is recommended that a burner of ample capacity be used in order that to crowd the steam pressure it may not be necessary to atomize the oil, as it would throw the flame too far backward in the fire pan and it will strike against the flash wall. Therefore, the burner should be of such a size that when the engine is working hard enough to cause the maximum amount of oil to be burned, i. e., 1½ lbs. per square foot of heating surface per hour, the oil can be atomized and thrown forward just far enough that the combustion will take place close to the front of the flash wall. The best position for the burner is in front of the fire pan, about 5 or 6 feet away from the flash wall.

There are two systems of oil burners in use. The horizontal and the vertical. Either one properly installed gives efficient service, although there seems to be a preference in favor of the horizontal system. Sufficient fire brick should be used to protect the parts desired and to give the right firebox temperature. Insufficient fire brick seems to have been one of the weak points of the oil burner, as the intense heat combined with the chemical action of some of the constituents of the oil seems to disintegrate the brick. The brick lining, therefore, is a constant source of expense. For that reason as little as possible should be used. There is reason in all things, and this is a chance for good judgment born of experience. A number of users have entirely dispensed with the brick arch formerly used in connection with oil burners. Water should not be allowed to accumulate in the oil tank, nor should the bricks obstruct the fire in the firebox. A smoking engine indicates a waste of fuel.

Never start out with oil that is not heated, about 100 degrees being sufficient. Use the atomizer at all times and sand out the flues and keep them clean. If the fire goes out, immediately close the throttle. The engine should never be moved without a fire in the firebox. The men should be cautioned not to approach a manhole or vent in the oil tank with a lighted torch or lantern. Double burners should always have both atomizers working and a uniform water level should be maintained at all times. Do not fail to close the block back valves. Different adjustments of the atomizers will be required for different engines. Work the fire in conjunction with the judgment of the engineer. Do not fill the oil tank more than within two inches of the top.

Swedish Iron Industries.

Exports of iron ore from Sweden showed a heavy increase. Last year 5,106,000 tons, valued at $13,325,490, were sent abroad, as against 4,413,800 tons, valued at $11,561,738, in 1910. For the first time the 5,000,000-ton mark has been exceeded. Germany purchased larger quantities than ever before, and the United States also appeared as a buyer, $1,350,000 worth being sent to Philadelphia.

During the year discussions concerning the possibility of radical changes in the methods of production in the iron industry continued with the same intensity as in 1910. It would seem that smelting by electricity has an assured future. It is impossible to predict its effect on the Swedish iron industry, but it is thought that the present center of the industry around the mines in central Sweden will gravitate to other parts of the country where the mines are located in or near mountains with waterfalls. This would refer especially to the ores of Lapland.

At present home industries take so little of the raw product that exports of iron ore to foreign countries are constantly increasing. This is evidenced by the fact that in 1911 about 520,000 tons, valued at about $1,350,000, were exported to the United States, and the American market is comparatively new.

Locomotives Undergoing Repairs.

About 10 per cent of the locomotives in the country are constantly out of service undergoing repairs. About 2 per cent. of this repairing can be done in roundhouses; so there ought to be 8 stalls in the track shop for every 100 engines belonging to a railway. Where the feed water on a line is heavy with impurities the percentage of locomotives undergoing repairs is proportionately greater, according to the nature of impurities.

New Railway in Ecuador.

The contract for the Huigra Cuenca Railway, a proposition which has been before the Ecuadorian Congress for several years, is now about to be signed. The company undertaking this work is American which, of course, means a chance for American materials. This railway is about 60 miles in length and, as has been reported, will afford access to the coal fields of Ecuador which are said to be very rich and from which the country hopes to obtain her coal supply. Cuenca is also the center of a rich agricultural district which at the present time can be reached by mules only, as there is not even a wagon road to the place.

Great Railway Project in China.

A Presidential Order empowers Dr. Sun Yat Sen to form a railway corporation for the purpose of financing and constructing a railway system throughout China, of some 70,000 miles in ten years, at a cost of £600,000,000, by means of concessions to foreign capitalists to build the railways and work them for a period of 40 years, when they would revert to the Chinese Government without payment. H. M. Legation state that the scheme has met with severe criticism from the native press in China.

What Railroads Do.

To transport each passenger, the railroads move four and a half tons of equipment or dead weight, useful only in making it possible to carry a passenger in safety and comfort.

For each family in the United States the railroads ship 75 tons annually; this is equal to one ton being shipped a total distance of 11,325 miles.

Each inhabitant of the United States takes approximately ten trips on the railroads yearly of 33 miles each. The cost of this service is only one and seven-tenths cents per day per capita.

Use of Luminous Paint in Great Britain.

Every year or two some extra discovery is made in the production of luminous paint and the world is promised covering for vehicles and railway cars that will make headlight and tail light a superfluity.

The latest in automobile paints comes from England. One of the largest firms there has just brought out a new varnish called "Lumino Aluminium Paint," and it is stated that the glow of the paint on a dark night is so bright that the car is visible for two miles without being fitted with lamps. People on the roads near the factory at first were frightened by the strangely glowing, lightless cars which silently skimmed through the village.

The McIntosh Spark Arrester.

The British Isles are so liberally supplied with moisture that there has been comparatively little fire raising due to sparks from locomotives and hitherto no decided demand has been made for the providing of locomotives with spark arresters. The increase in the size of locomotives has, however, led to huge spark throwing and the authorities decided recently that something must be done to restrain spark throwing, with the result that locomotive superintendents have begun to introduce spark arresters.

Among the first of the British railway officials to assail the spark arrester problem is John F. McIntosh, locomotive superintendent of the Caledonian railway, who designed and is applying the apparatus shown in the annexed engraving, which is copied from *The Railway and Travel Monthly*.

In front of the tube plate, within the smoke box, are two vertical plates forming a V between the tube plate and the exhaust pipe. Sparks issuing from the tubes strike the V plate and are deflected towards the front corners of the smoke box. The cinders are prevented from ascending the stack by sloping wing plates, which deflect the sparks downwards toward the front of the smoke box. Should any cinders escape the action of the V plate and deflectors they impinge against the louver on the inside of the smoke box door. As the cinders collect on the bottom of the smoke box, they are supposed to gradually move back towards the angle of the V plate, where they cool till raised by suction up a horizontal pipe leading to the smoke stack.

THE McINTOSH SPARK ARRESTER.
Caledonian Railway.

In this connection we should like to direct the attention of Mr. McIntosh and other British locomotive superintendents, to the Westralian Improved Rotary Spark Arrester, which we have had the opportunity of examining and which has already met with the approval of many railroad experts both in Australia and America.

To Visit Home of Washington Family.

Americans touring England will be glad to learn, says *The Railway and Travel Monthly*, that when visiting Stratford-on-Avon, Shakespeare's birthplace, they can, by booking to Morton Pinkney station on the Stratford-on-Avon and Midland Junction Railway, visit the ancient home of the Washington family, which is Sulgrave Manor, only 2½ miles from Morton Pinkney station.

Sulgrave is situated in a quiet rural neighborhood, where the old-style farmhouse still abounds. A part of the old manor-house still remains, and the Washington crest (from which the "stars and stripes" originated), in colored glass, is to be seen in a window of what is now the buttery. Another window in which the old family coat-of-arms was emblazoned, has been removed to the residence of the actual proprietor of the Manor. A rookery still exists in a grove hard by, where rooks built, and reared their young, in the days when the Washingtons still lived at Sulgrave. In the pavement of Sulgrave Church is shown a stone slab bearing effigies on plates of brass of "Laurence Washington, gent., and Anne his wife, and their four sons and eleven daughters." The inscription in black-letter is dated 1564. The arms of the Washington family, the stars and stripes, also appear in the church.

Medicinal Vegetables and Fruits.

The irregular eating times of trainmen makes them peculiarly subject to stomach disorders that often result in the miseries of chronic dyspepsia. The habit which many men acquire of swallowing their food without being masticated properly, accelerates the period of stomach miseries. In selecting food that will promote or retard digestion the following data will be found useful:

Watercress is an excellent blood purifier.

Lettuce has a soothing effect on the nerves and is excellent for sufferers from insomnia.

Tomatoes are good for a torpid liver, but should be avoided by gouty people.

Beet root is fattening and good for people who want to put on flesh. So are potatoes.

Apples, carrots and Brazil nuts are excellent for sufferers from constipation.

Raw carrots cure indigestion. When cooked they will cure asthma.

Celery contains sulphur and helps to ward off rheumatism. It is also a nerve tonic.

Bananas are beneficial to sufferers from chest complaints.

Strawberries and onions produce a creamy whiteness to the complexion.

Cauliflower is at all times preferable to cabbage.

Slow eating promotes digestion.

Questions Answered

RAIL JOINTS AND FLUES.

(218) W. G. L., New York City, writes: (a) Why are fish plate bolts alternated, that is, the head of the bolt first on one side of the rail and then on the other? A.—This practice is deemed likely to insure the stability of the bolts holding the plates as the thread on the bolts extending some little distance into the plate does not furnish a very large bearing on the plate at the end to which the nut is attached, and by alternating the bolts the plate is more likely to be secured.

(b) Why are not rail joints beveled at an angle similar to draw bridge joints to lessen the jar? A.—Experiments have been tried with this method of jointing rails and it was found that the tapering joints wore away much more rapidly than the square joint, and increased instead of lessening the jar.

(c) I have an idea that the twenty or more large flues employed in connection with a superheater has something to do with the resulting economy, on account of offering less impediment to the rising bubbles of steam and hence producing steam more rapidly. Is there anything in this? A.—No. Boilers with comparatively large flues consume more fuel than those of smaller dimensions such as are in use on locomotives. This may be readily accounted for from the fact that a large heating surface tends to economy in fuel, and the larger the body or bodies of water the greater amount of heat units will be required to penetrate the mass.

(d) Suppose some flues were carried from the top of the firebox up to and above the water line, and thence to the front end. These could not burn out, being surrounded by wet steam. Upright boilers have part of their flues out of water, and I should think would dry the steam and possibly make combustion more complete, and increase the efficiency of the boiler. What do you think? A.—We think that the tendency of flues so placed to burn out rapidly or collapse would be very great. In upright boilers the exposed parts of the flues are at a considerable distance from the fire, and usually subjected to much lower pressure than on the modern locomotive.

LOCOMOTIVE OPERATING.

(219) I. E. M., Crewe, England, writes:

(a) Does actual experience prove that large grates are a means of economy? I have read the reports on American testing plant results but on the other hand English results in practice do not correspond. Burning hard, dirty, clinkering coal, our engines with superheater and grate 22½ sq. ft., will haul trains of some 400 English tons behind the tender at an average speed of 55 miles per hour for some 150 miles on 40 lbs. of coal per mile in the more level districts out of London, or 45 lbs. per mile in the hilly northern districts with grades of 1 in 100. This with coal that needs to have the clinker broken up every 100 miles and leaves you with a box full of dirt that will not burn. Do American figures for your huge grates beat these for such heavy work? A.—We have had reason to believe that D. K. Clark was correct when he wrote that the smaller the grate consistent with proper admission of air the greater would be the economy of a locomotive furnace. Certain railways in the United States have found that heat economy was promoted by putting dead grates in large locomotive fireboxes.

(b) In enlargement of the last query, what are the average figures in America for similar work with your cylinders of from 25 to 27 ins. x 28 in. Ours are only 21 x 26, with 81-in. drivers. I may say that we experience no difficulty in making up lost time on the above service, though a certain driver who has no proper idea of working his engine will burn 50 lbs. per mile or more in covering the 158 miles in 160 odd minutes with 400 tons behind the tender. A few of our passenger engines have cylinders as large as those mentioned. On the Erie Railroad engines with cylinders 22½ x 26 take trains weighing about 400 tons behind the tender over undulating divisions on from 80 to 100 lbs. of coal per mile.

(c) What is the experience with 20 ft. flues? Do they not sag and set up tubeplate leakage? Do you not find that short boilers are the best steamers, and can be worked with larger nozzles? With 12 ft. flues we can always keep our engines blowing off even on the above service, and with almost any coal with 6 in. nozzle. What is an average nozzle with you? A.—There is some trouble with long flues sagging. Boilers having flues from 12 to 15 ft. long are most satisfactory for service and for durability. Our average single nozzle is from 5 to 6 ins. diameter. Many of our engines have double nozzles from 3 to 4 inches diameter.

(d) Do inside admission piston valves compare favorably with those with external admission, and with slide valves as regards economy? English results seem against them. A.—Inside admission piston valves are more in favor with us than those with outside admission.

(e) On the score of repairs America does not favor compounds excepting the A. T. & S. F., but do you not find them more reliable and economical? What I have seen and heard of well designed compounds here is most decidedly in their favor. Enginemen are very keen on them, as are those in charge of the running sheds. A.—With the exception of Mallets, compound locomoties have not met with favor on American railways. Any economy of repairs has been swallowed up by extra repairs.

(f) For new engines which is most favored, Wood, Jacobs-Schupert, or ordinary firebox with flexible stays? A.—Ordinary firebox.

(g) As regards cylinder lubrication for superheating I hear that it has been found best to lead all the oil to the steam pipe and not to lead it to the valve chest bushings and cylinder barrel. Can you endorse this? For temperatures of 650 F.? A.—Yes.

(h) Is it usual to use your six-coupled engines for your fastest services, and is their repair cost not considerably higher than that for four-wheel coupled engines, that is are not the Pacific classes far more costly to maintain than the Atlantic? We get most successful results with 4-4-0 engines, results that I fancy are not much behind those of your 4-6-2 engines, while the cost (the capital involved) is greatly disproportionate. A.—For heavy through passenger service six-coupled engines are used almost entirely. They cost more for repairs than 4-4-0 or 4-4-2 engines do, but they get there as our people say.

(i) Do you find tail-rods any advantage? A.—No.

(j) Do you not find large tube plate bridges, such as ⅞ in. has a bad effect on the steaming of the boiler as compared with ¾-in. bridges or less? A.—We never heard any objection raised to the large bridge. Where scale making fixed water is used the large bridge is an advantage, as it provides more room for circulation.

TRACTIVE FORCE.

(220) G. T. L., Lorel, Que., writes: Would you kindly state what is the tonnage or hauling capacity of a locomotive with the following dimensions: Cylinders, 18 inches diameter, stroke 24 inches, 140 pounds steam pressure, and diameter of driving wheels 56 inches.—A. 744 tons. The answer is found by multiplying the square of the diameter of the cylinder in inches by the length of the stroke in inches, and multiply this amount by 85 per cent. of boiler steam pressure and divide by the diameter of the driving wheels. The following is the calculation: $18 \times 18 = 324 \times 24 = 7776 \times 119$ (which is 85 per cent. of 140) $= 925{,}344 \div 56 = 16{,}524$ pounds. This represents a tractive force of 826 tons. Ten per cent. should be deducted for friction, leaving an available tractive force of 744 tons nearly.

It may be added that there are a number of formulas and methods of obtaining the tractive force of locomotives but the above is as simple and as nearly cor-

rect as any. It should be borne in mind, however, that the hauling capacity of a locomotive is determined by the relation between the tractive force developed and the resistance of the train, and both of these factors are dependent on the speed. The above example simply shows the tractive force of the locomotive at starting. The subject in all its bearings is fully discussed in Dr. Sinclair's "Twentieth Century Locomotives."

INCORRECT MANIPULATION AND DEFECTS OF BRAKE VALVE.

(221) J. R. C., Moncton, N. B., writes: Will you please answer the following questions in your columns: (a) What are the four most common errors in handling the automatic brake valve? (b) What is the unusual indication of the brake applying quick-action in a service reduction? (c) What will cause the same action of the brake valve and thereby be deceptive, when no undesired quick-action has occurred? (d) What will be the effect of omitting the angle fitting at the service exhaust of the brake valve, or using one with a larger or smaller opening? A.—(a) What constitutes the four most prevalent incorrect movements of the brake valve handle may be largely a matter of opinion, but we think the four mistakes most frequently made under ordinary conditions of train braking are an unnecessary movement to release position just before or during the ascent of a grade, stopping the valve handle on lap position before making an application, going past the service position during ordinary stops that should be made entirely in service position, and leaving the handle too long in release position when releasing brakes. (b) The usual indication that quick-action has taken place is that when it occurs the brake pipe exhaust ceases or if quick-action occurs about the time the exhaust should close the equalizing discharge valve will not respond if an attempt is made to continue the reduction. (c) A premature cutting off of the brake pipe exhaust may be caused by a very leaky equalizing piston packing ring or by leakage into the chamber above the piston, but if the train is at rest the brake cylinder gage will show whether or not quick-action has taken place, and if the train is in motion the braking effect developed by the undesired quick-action will leave no doubt in your mind as to whether or not quick-action has occurred. There are, of course, other conditions which might result in the brake valve exhaust being cut off, as uncharged cars being coupled up or serious leakage will affect the operation of the equalizing piston and noticeably so if an application is attempted while the feed valve is working its full capacity, as the piston will not be lifted for some little time after the reduction in the equalizing reservoir is started. (d) The effect of too large an opening in the brake valve service exhaust fitting tends to contribute to undesired quick-action, but as in nearly every other air brake defect the effect depends upon other conditions. In this case the conical end of the piston stem retards the escape of pressure to such an extent that quick-action does not occur from this cause alone. The effect of too small an opening will be to retard the escape of pressure, and while it may result in a more uniform reduction, some brakes in a long train will likely fail to apply due to the reduction being slower than intended. The size of the service exhaust port of the H6 valve is 1/4 of an inch and in the G6 brake valve 9-32 of an inch.

BRAKE FAILS TO RELEASE.

(222) J. M., Ft. Wayne, Ind., writes: We have had several cases of engine brakes failing to release with the independent brake valve while the automatic valve is on lap, due to wrongly connected air pipes and to metal thread protectors not being removed from the independent brake valve exhaust port when put in service. When this occurs and is not noticed until an attempt is made to release with the independent valve under the condition of train brakes being applied, can you get the engine brake released without releasing the train brakes also? A.—Yes, if the pipes are wrongly connected. Close the brake valve cut-out-cock and place the automatic brake valve handle in running position. The independent brake valve should remain in running position, and when ready to release train brakes move the automatic valve to release position and place the cut-out-cock in its normal position.

We cannot recommend any practice of this kind. We believe that the brake equipment should be thoroughly inspected before the locomotive leaves the engine house. It is obvious, however, that a quick-thinking man might prevent some damage to driving wheel tires under the circumstances you mention.

DEFECTIVE DISTRIBUTING VALVE.

(223) M. M., Springfield, Mo., writes: On an engine equipped with the No. 6 E. T. brake, the pressures are pumped up and no leaks found in the pipes or from the exhaust ports of any of the valves, but after an application with either brake valve, and return to release, there is a constant blow of air from the exhaust port of the automatic valve and the brake will not release, from ten to twenty pounds pressure remaining in the brake cylinders. This only occurs at times, and tapping the distributing valve sometimes stops it. The equalizing valve seems to have a good bearing surface on its seat, and the valves generally seem to be in good condition. Could you kindly let us know the probable cause of the brake sticking? A.—Your trouble is no doubt due to a worn-out or stuck packing ring on the aplication piston in the distributing valve. There must also be considerable frictional resistance to the movement of the application portion, and when the release is attempted the piston may not always return fully to release, and when the brake acts as you describe it is pretty safe to conclude that the piston has stopped in a position that will admit a small amount of air to the brake cylinders, and some of the maintained pressure is then passing the stuck ring, beating down the packing leather and entering the application cylinder. The first symptom of this disorder is that when an application is made with either brake valve, the brake continues to apply after the handle is returned to lap position; that is, brake cylinder pressure rises to the adjustment of the safety valve.

SAFETY VALVE LEAKAGE.

(224) W. J. P., Windsor, Ont., writes: (a) What is meant by the term E. T. equipment? (b) If the safety valve on the double check valve blows when the straight air brake is applied, where would you look for the trouble?—A. (a) In the nomenclature of the air brake. the symbol E. T. means engine and tender. (b) In the safety valve or in the reducing valve. To determine which part is at fault, make a light application with the straight air brake valve and return it to lap position, if the safety valve blows you may expect to find it out of adjustment, a weakened adjusting spring, a stuck piston valve, or a bad leak on the piston valve seat. If the blow does not start until 45 or 50 lbs. brake cylinder pressure is obtained, you may expect to find an inoperative or an incorrectly adjusted reducing valve.

BRAKE RELEASES.

(225) J. M., Ft. Wayne, Ind., writes: What could be wrong with the E. T. brake on the second engine in double-heading when the brake will not remain applied when an application is made from the first engine? A.—Assuming that this trouble is experienced only when double-heading, it can be due to a pressure chamber leak, a leaky slide valve or leaky graduating valve in the distributing valve or to wrongly connected application cylinder and release pipes. In case no air pressure escapes from the automatic brake valve when the brake is releasing, it indicates a leak from the application cylinder, the application cylinder pipe, or through the safety valve. Of course, a leak of main reservoir pressure into the brake pipe, coming from either engine might cause this, but some of the train brakes would likely be released at the same time.

Railway & Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances.

Published Monthly by

ANGUS SINCLAIR CO.

114 Liberty Street, New York.

Telephone, 746 Rector.

Cable Address, "Locong," N. Y.

Glasgow, "Locoauto."

Business Department:

ANGUS SINCLAIR, D. E., Prest. and Treas.

JAMES KENNEDY, Vice-Prest.

HARRY A. KENNEY, Secy. and Gen. Mgr.

Editorial Department:

ANGUS SINCLAIR, D. E., Editor.

JAMES KENNEDY, Managing Editor.

ALLEN G. WOOD, Consulting Engineer.

GEO. W. KIEHM, Associate Editor.

A. J. MANSON, Associate Editor.

Boston Representative:

S. I. CARPENTER, 643 Old South Building, Boston, Mass.

London Representative:

THE LOCOMOTIVE PUBLISHING CO., Ltd., 3 Amen Corner, Paternoster Row, London, E.C.

Glasgow Representative:

A. F. SINCLAIR, 15 Manor Road, Bellahouston, Glasgow.

SUBSCRIPTION PRICE

$2.00 *per year.* $1.00 *for six months, postage paid in the United States, Canada and Mexico. For other parts of the world,* $2.50, *or ten shillings. Single copies,* 20 *cents. Remit by Express Money Order, Draft, Post Office Order or Registered Letter.*

Mailing address can be changed as often as necessary—always give old and new address, and if you subscribe in a club, state the name of the agent.

Please give prompt notice when your paper fails to reach you regularly.

Entered at the Post Office, New York, as Second-class Mail Matter.

Sustaining Combustion by Dead Gases.

An examination of the patent records reveals many curious, wonderful and amusing attempts to perform impossibilities. Our attention was called lately to patents connected with boiler construction through an inventor showing us the model of an improvement he had designed for obtaining more of the heat out of the fuel gases. The man had heard of the advantages obtained in metallurgical processes from the use of a hot blast, and he conceived that what was good for melting iron would not be bad for making steam. He proposed obtaining a hot blast for the locomotive simply by carrying the hot gases from the smoke stack into the ash pan. There was to be no end of heat saving from the process.

It was new information to this improver of the locomotive boiler, when we tried to explain that the gases passing out through the smokestack were dead fumes, that had no more power to sustain combustion than the breath passing from the lungs was capable of sustaining life if drawn separately back again. We are aware that men who knew nothing of nature's laws had previously proposed using the hot dead gases to sustain the living fire; but we are surprised on searching through the patent records to find how often methods to be operated on that principle had been covered by letters patent. A hot blast, or the supply of heated air to sustain combustion in a steam boiler, would no doubt help to maintain a high furnace temperature, a very great aid to economy, but air is so hard to heat, and absorbs heat so slowly from any hot surface it passes over, that there is no hope of ever applying its benefits successfully to locomotives.

Smoke.

Considering smoke in locomotive practice, it may be said briefly that it is due to the presence of unburned gases and particles of coal or unburned carbon. The products of combustion—carbon dioxide and carbon monoxide—when fixed carbon burns are colorless, and the burning of a good grade of anthracite coal, which is largely carbon, is attended by little smoke. Soft coal contains about 5 per cent. of hydrogen, which is expelled when the coal is heated to about 1,200 degrees Fahr. The gas at this time combines with about three times its weight of carbon, which results in about 20 per cent. of the coal being converted into gas, which, mixed with other volatile parts of the coal, has a brownish color. While carbureted hydrogen gas cannot, in the full meaning of the term, be called smoke, yet if it is not properly burned the result will be the formation of small particles of unburned carbon, or soot, or smoke in a truer sense.

When this gas is set free the hydrogen burns first, if the firebox temperature is high enough, about 1,800 Fahr., as it is the most combustible of the two elements uniting with the oxygen to form water. The carbon set free when the hydrogen burns is intensely hot and it combines with oxygen to form carbon dioxide, and combustion is perfect. If insufficient oxygen is present it passes off unburned, and when cool forms soot, as carbon is never found in a gaseous condition when not combined with other substances.

Smoke consists therefore of carbureted hydrogen gas that escapes from the coal and passes to the atmosphere when the firebox temperature is below the igniting point, and in addition soot that escapes when the gas is burned at a high temperature in connection with an insufficient supply of oxygen. It will be readily noted therefore that the prevention of smoke implies that the firebox temperature should be sufficiently high to burn the carbureted hydrogen gas as it is evolved, and further that sufficient air be present to insure it being fully burned to carbon dioxide and water. Keeping as high a firebox temperature as possible, and at the same time admitting enough air for complete combustion, may be relied upon as the important factors in preventing smoke.

It should also be observed that firing light and frequently spreading the coal evenly and closing the firebox cover quickly after each charge of coal, and keeping a clear, bright fire, and having the fire thick enough to withstand the action of the exhaust from pulling it full of holes, will decrease the amount of smoke emitted, provided the engine is drafted properly and is in condition to steam without continually urging the fire. The reverse lever also should not be placed lower than is necessary. It may be added that the carbureted hydrogen gas formed from the burning of soft coal is what is known as coal gas, or illuminating gas, when prepared in special apparatus where its impurities are removed.

Training of Foundry Apprentices.

We are not acquainted with any line of industry in the United States where apprentices are employed that devote less attention to the training of the youths supposed to be learning the trade than that of apprentices in foundries. Dr. Otto Brendt, of Germany, read a paper lately on "The Education of Apprentices in the Foundry," in which he outlined the training of apprentices in Germany, which ought to be adopted by every public spirited foundryman in this country. He remarked that the foundry, although using machinery to some extent, is still one of the places in which skill of hand and judgment play an important part in the attainment of first-class work.

The foundry is one of those industries which has to provide for its own supply of skilled men since there are no other related industries which could serve in any way, or be useful as preparatory agencies for the trade of molder.

The rules under which apprentices are accepted in Germany are quite uniform. They are based upon the customary written apprenticeship contract with a trial period and an increasing scale of wages. In some large shops the best boys are given piece work during the last year to give them an opportunity to earn more.

It is frequently the custom to assign an apprentice to the care of a skilled worker as a helper in order to receive practical instruction. The increase in earnings of the workman due to the help of the apprentice is his compensation for teaching the boy. If, however, the boy makes rapid progress and the foreman

notices the earnings of the teacher-workman rises rapidly, due to the efficient help of the boy, then the boy's pay is gradually deducted from the earnings of the workman and if still rising then the workman is requested to give the boy some extra compensation. In order to attract boys and to prevent their gravitating towards the larger industrial centers, premiums are often paid ranging all the way from twenty to seventy-five dollars, payable at the expiration of the apprenticeship. Apprentices everywhere are compelled to deposit a small amount of their earnings with the works' saving fund, which is returned to him with interest at the end of his apprenticeship.

Every employer has to send his employees under eighteen years of age to a continuation school for a prescribed number of hours per week, be it a shop school or a school provided by the municipality.

The character and extent of the apprentice school at a works is naturally determined by its nature and extent. It may be a general apprentice school without specialization for special branches, or whether it is an industrial continuation school with special branches.

Every employer is at liberty to maintain a school of his own on his own premises at his own expense. But if so, the school must conform to certain government requirements, concerning number of hours taught per week and given subjects.

The Open Switch.

The open switch has led a good many trains to destruction within the last year, and it seems impossible to prevent some brakemen from leaving the switch open when they admit trains to sidings. We think it is possible to establish greater sense of responsibility upon trainmen by impressing upon the younger men the necessity for exercising care in performing their duties. The ordinary routine with new brakemen is to set them to work and permit them to learn their duties by experience. Some of these men turn out to be ideal railroaders, the kind of men who move steadily up to the ladder of official standing; but others follow the practice of doing nothing more than compulsion puts upon them. This class nearly always contains the careless men who neglect to close the switch and are mildly sorry for the destruction their criminal apathy brings about.

On some roads there have been of late movements organized to form departments for the prevention of accidents, which are certain to exercise an excellent influence on railroad life. Committees are elected from the various departments, meet once a month and report to a Central Safety Committee where methods for preventing accidents are discussed. Anything which will impress upon railway men generally the duty of conserving safety is bound to have a good effect. There has been in the past a miserable spirit of so-called loyalty to class which influenced men to shield other trainmen from detection for faults that ought to have been exposed, even the crime of drunkenness while on duty. If the department for the prevention of accident will influence members to report on dangerous personal habits of others, the results will be highly beneficial. Fellow employees soon come to understand all about the habitually careless and reckless men, and it is to be hoped that safety sentiment will work up to the point where every man becomes ready to expose practices likely to bring about accident.

Meeting Place of Railway Conventions.

The Joint Committee of the Master Car Builders and of the Railway Master Mechanics' Associations met in New York, November 14, for the purpose of deciding where the next annual conventions would be held. Applications from only two places were made offering facilities for the conventions, viz., Atlantic City and Washington, D. C. The people of Washington were willing to erect a special building for the accommodation of the exhibits and the technical meetings, but the best hotel charges mentioned were $3.50 a day and upwards on the European plan. When board was included, that would be about double the rates charged the members at previous conventions. Atlantic City people were prepared to increase the meeting hall used for the convention in past years, and the hotel rates are to be the same as last year. The voters decided on going again to Atlantic City.

The Master Mechanics' Association meetings will be held first this year on June 11, 12 and 13. The Master Car Builders' Association will meet on June 16, 17 and 18.

It is to be regretted that so few places are now ready to bid for these conventions, a condition of affairs due to the difficulty of providing room for the exhibits which have of late years become a recognized part of these conventions. There has been much talk of late years concerning the vast sums of money expended by the supply interest for the Railway Mechanical Conventions, but very little money has gone to the entertainment of the members and their friends. At the coming convention the members of both associations have arranged to defray their own expenses as they did at last convention.

Instead of the members of the Railway Mechanical conventions being under obligations to the people who promote and patronize the exhibits, the obligations are entirely on the other side, for were it not for looking out to have proper accommodation for the supply men's exhibits, the association could hold their conventions at any one of a variety of cities extending from Denver to Boston. Atlantic City is a convenient place for the crowds that now attend the mechanical conventions; but a place more central would be much more convenient to the members of the association. If the conventions were held in Chicago, Cleveland or St. Louis, it is safe to say that double the number of members would attend that now go to Atlantic City. The fact ought not to be forgotten that the conventions are held for the benefit and instruction of the railway mechanical men, and the location which will draw the greatest number of them ought to be chosen every time.

The Care of Wedges.

The wedges on a locomotive, as all of us should know, are intended to take up the lost motion between the driving boxes and the jaws of the frame. A very little lost motion at this point causes a pound which shakes and jars the whole machine, and in time will loosen the brass in that box, as well as spoiling the parallel rods. A very good reason why a loose wedge or loose driving box brass pounds so much worse than the same amount of lost motion in the main rod is because there is so great a leverage exerted on it by the connections from the pistons.

If we consider the box on the other end of the axle as the fulcrum you will see that the defective box is about one-third of the distance from the crank pin, which gives it the power across to the other box. The care and proper adjustment of the wedges is a matter of the first importance if the engine is to ride smoothly and maintain the driving boxes and rods in good order. If a wedge gets loose and works down, set it up at the first opportunity. Do not wait till next trip any more than you would to fix a main rod with one of the keys loose and working out.

To locate a wedge which needs setting up, stand the engine with the crank pin on the top quarter on the side you are about to examine. This position will put the eccentric straps up out of your way on the main axle, and gives the best chance to see any movement of the driving box between the jaws of the frame. If there is a driver brake, cut it out and hold the engine with the tender brake or by blocking the wheels. If you set the driver brake it will hold the boxes solid, so that you will not notice any lost motion. Have the fireman reverse the engine several times with a moderate pressure of steam in the cylinders, and watch the box; if it moves back and forth between the jaws, as the steam pressure is changed from one side to the other of the piston, the trouble is located and should be remedied

at once if possible. The test will locate right off whether the pound is between the journal and the box or between the box and the wedge.

If the wedges are in good order, that is, with the proper taper and smooth bearing surfaces, they should be moved up by the wedge bolts till they are tight and take up all the lost motion. This will locate the exact point at which they are too tight so they are liable to stick; you can then draw it down just enough to allow the box a free movement up and down with the least possible amount of play forward and back; about one-sixteenth of an inch is enough to pull it down, after which the jam nuts should be made fast again.

Some wedges also have a bolt through the side of the jaw, which holds the wedge. This must be slacked off before the wedge is moved, and made tight after the wedge is set.

If you wish to make a speedy and certain job of this work get under the engine, slack off the jam nuts and get wedges loose and started up; have two men with pinch bars pinch against each other at the same wheel, which will lift the wheel up off the rail. As long as the box moves freely the wedge is not too tight; when it begins to stick the men will raise frame and all. If the wedge or shoe is worn more in the middle than at the bottom end, the box is apt to stick before the wedge is tight at the top. The pinch bar method will locate this trouble at once, as well as showing the case of the wedge sticking on the jaw so it will not move. If this is a new way to you it is well worth trying at the first opportunity.

The wedges should be set up when the engine frame and boxes are warm, as expansion cuts quite a figure in this matter. When a box begins to get hot, slack down the wedge before it sticks, unless you can cool off the box at once. Sometimes the first notice you have of a hot driving box is a stuck wedge.

If they stick very bad and catch on the box, the wedge bolts are liable to break. This may let the wedge work up and jam solid against the taper side of the jaw. Look out for this. In case of a stuck wedge run the other wheel on that side over a block which will lower the box on the stuck wedge so you can get it loose.

If the wedge bolts break off, sometimes they can be spliced so as to hold as well as ever. This refers to wedge bolts which go through the pedestal binder and having nuts both above and below the binder. They usually break off at the top of the nut which is above the binder. Probably the nut does not fit square on the binder and strains the bolt to one side till it breaks off. Run the top nut up on the part of the bolt which goes into the wedge so that it is about half way through the nut; take out the lower part of the broken bolt and slip enough washers under the nut to fill in the space; then screw the bottom end of the bolt up into the nut through the washers. This makes a splice of the bolt in the middle of the nut, and the washers under the nut hold the wedge up. A bolt well spliced in this manner will sometimes last longer than a new one, as it is more flexible.

When the head of the wedge bolt is not a good fit in the wedge, so that the wedge can work up and stick or work down and pound, in case there are two bolts to each wedge, set it up where it belongs with one bolt and then pull the other one down to hold it there, so the wedge cannot work either way. If there is only one bolt—like the Baldwins—after putting the wedge up properly, block it at the bottom end with a nut, if of the right size; or with a piece of hardwood, cut of the right length, to go between the bottom of wedge and binder. A piece sawed off an old coal pick handle does as well; there is room for it between the jaw and the bolt, so that it won't work out. The bolt should then be set to hold the wedge down solid on the block.

Steel boxes wear out and cut the cast iron wedges much faster than iron ones do. They are apt to stick with very little provocation. The steel boxes require more oil to keep them from cutting any other rubbing surface that comes against them.

A brass liner on the faces of shoes and wedges makes a good job and wears smooth, which cast iron against a steel box will not do. Therefore, you cannot wear cast iron wedges as snug a fit against steel boxes as against cast iron or brass boxes.

The engines built by William Mason had two shoes, one on each side of the box, and inside of one shoe was the wedge; so that the shoe did not move up or down. The wedge was moved up and down by a bolt which was tapped up into the bottom end of the wedge. This wedge bolt had a collar about in the middle, which rested on the binder. The lower part of the bolt came down through the binder. It had jam nuts to hold it when set, and a square head so it could be turned from below. To move the wedge up, the bolt was turned to screw the bolt out of the wedge. As the collar kept the bolt from coming down, the wedge had to go up. The wedge and all of the bolt above the binder being hidden by the shoe outside of it, made this arrangement a puzzle till a man saw one taken down.

A good many of the old country locomotives do not have any wedges. The jaws are parallel. Lost motion is taken up by slipping a liner of the proper thickness between the shoe and the jaw. Some companies have tried the same plan in the United States, but it does not give as good results as our plan of a wedge on one side. Possibly the fact that they are experimented with on heavy passenger engines, which, of all others, need the most delicate adjustment for lost motion at there boxes has had something to do with their failure. Had this solid fixed wedge been tried on switch engines first, so that the machinist who make them, and repair men who are expected to keep them in order, could catch on to the troubles with their operation and learn the best methods of caring for them, possibly we would hear less of their failure.

Wedges are not a new invention. The writer ran some years ago a Rogers, Ketchum & Grosvenor engine that had two wedges for each driving box. This engine was at one time on the New York Central, then came to the Detroit & Milwaukee. Previous to 1854 she was named the "Empire."

Improving the Locomotive Boiler.

The boiler of the locomotive has excessively difficult duties to perform when it supplies without inordinate waste the ever-varying steam requirements of cylinders developing the power to run fast or heavy trains over an uneven country. A well designed boiler—and most American locomotives have well designed boilers—performs its functions as efficiently as any ordinary mechanical appliance, yet there is a widespread belief which is not confined to the outside of engineering circles, that the locomotive boiler is very defective indeed. As American inventive talent prides itself in rising to provide remedies for all mechanical imperfections, it is not surprising that the alleged defects of the locomotive boiler have not received particular attention from that class of inventors who are prepared to design improvements for every appliance, no matter how little they may understand about its duties. The man who is prepared to save 25 per cent. of the coal used in the locomotive firebox by the use of a patent grate bar may still be found with his model in his gripsack convenient for inspection. The enthusiast who has a smoke consuming appliance that he alleges will save 50 per cent. of the coal, is not yet blotted out by the skepticism of master mechanics, and those who are to save all the remainder of the fuel used, by means of patent ash pans, spark arresters, feed water heaters and other inventions are still round vigorously attending to business, as most railroad officers are ready and willing to testify.

We are far from wishing to depreciate efforts to reduce the quantity of coal used to generate steam in locomotive boilers, but at the same time we would like to point out that the possible saving is much more limited on well managed roads than many people believe it to be. A well de-

signed stationary or marine boiler with natural draft and well fired will utilize about 80 per cent. of the heat in the coal for steam-making, and about 20 per cent. will be lost by the hot gases passing through the chimney. It will never be possible to do much better than this, for the heat in the waste gases must necessarily be higher than the temperature of the boiler. These results are obtained under conditions that never can be equaled with a locomotive when a small boiler must be forced to evaporate a large quantity of water to the foot of heating surface. There are locomotives running on many railways, pulling heavy or fast trains, that utilize about 60 per cent. of the heat developed by the coal. Engines of this degree of efficiency are rather exceptions, as the accounting of 50 per cent. of the heat is about the ordinary average; but the locomotives making the best use of their coal have no features about them that all engines on American railroads might not easily possess. Plenty of grate area and liberal heating surface in proportion to the cylinder capacity is the first requisite, which is supplemented by careful firing. With the high steam pressures becoming established, and the rapid flow of the gases necessary to generate steam with the rapidity it passes through the cylinders of a locomotive, doing the work of moving our heavy trains, it will never be possible to reduce the smoke box temperature much below 600 degrees Fahrenheit. That being the case, the utilizing of 60 per cent. of the fuel heat is getting close to the possible limit.

Good firing is an essential that must never be lost sight of where efforts are made to cause a locomotive boiler to do its work to the best advantage. When this is attended to, the engine is suffering from some structural defect if the heat represented by the steam does not come close to 60 per cent. of the potential energy of the fuel. The most common mistake has been that of making the boiler too small for the cylinders, but it may occasionally be found that a boiler is large enough, yet badly proportioned in other ways. Superheated steam is making the locomotive a wonderfully economical steam user, so that its performance compares very favorably with that of the highest class of automatic steam engines.

Fuel Energy Utilized by a Locomotive.

In a paper read before an engineering society, on the "Economical Generation of Steam Power," the following statement was made: "For the best non-condensing engines we would realize 6 per cent. for ordinary non-condensing engines, such as are found in the average factory, about 3 per cent., and when the boiler is inefficient and the attendance careless, no doubt not more than 2 per cent. of the total heat units in the coal are utilized in actual work."

This statement is apt to strike many people as an exaggerated description of the wasteful conditions ordinary steam engines are worked under, yet a little calculation will indicate that the figures are substantially correct. Let us examine the performance of a passenger locomotive which is reputed to be one of the most economical non-condensing throttling steam engines. A locomotive that will take six heavy passenger cars over a fairly level road at an average speed of 30 miles an hour, with a coal consumption of 35 miles to the ton, will be regarded as doing fair work on well managed roads, and it will be far above the average performance on roads where the locomotives are not well looked after.

One pound of the common run of coal used by railroad companies contains about 12,000 heat units when burned with the full admixture of oxygen, each unit being the amount of heat capable of raising the temperature of 1 pound of water 1 degree Fahr. When converted into work, each heat unit is equivalent to 778 foot pounds, or possesses the energy, when no waste takes place, of raising 778 pounds 1 foot. At this rate each pound of coal represents 1,200 x 778 = 9,336,000 foot pounds of work, were it possible to utilize the whole potential energy reposing in the coal.

A train of six passenger cars, loaded, and an engine and tender in working order weigh about 360 tons. Careful experiments have shown that a train of this character can be moved at a speed of 30 miles an hour on good level track, on a power expenditure of 9.5 pounds to the ton. This will represent a constant force of 3,420 pounds, which being extended over one mile or 5,280 feet, represents 18,057,600 foot pounds as the work done in moving the train over each mile run. The effort exerted by the locomotive amounts to 547 horse power.

Taking 2,000 pounds as a ton of coal, it will be found to aggregate what looks as the enormous sum of 18,528,000,000 foot pounds, which, if used without loss would move our train close on 1,300 miles. As the locomotive only takes the train 35 miles with the quantity of coal named, it will be found that the energy of the coal converted into useful work is only 3 per cent. of the quantity used. That is, out of every 100 pounds of coal thrown into the fire box, nearly 97 pounds are lost or are wasted in holding up the other 3 pounds to do work. It looks as if engineering skill and scientific knowledge might devise means to capture some more of the power that passes away through the smokestack, yet on most of our railroads this line of possible saving receives no attention.

It might seem at first sight that these figures are in gross contradiction of present day practice, but the above figures are theoretically correct.

Age of Retirement.

The rules established regulating the retirement of railway men at a certain age appears to be influencing the higher officials, as well as those of lower degree. It used to be the practice of general managers, presidents and others high up in practical operation of railroads, to hold on to their jobs till they were carried to their graves, and at one time the practice was commended as showing devoted zeal for the interest of the company. It was, however, mistaken zeal, for a man verging on dotage might hold on and imagine himself useful and even indispensable; when he really was a heavy drag upon progress, and with the conservative habits of old age obstructed changes that were absolutely necessary. People who can look back on railroad life for forty years see many cases where officials long past the age of usefulness clung to positions they had become incompetent to fill and kept back younger men whose active services were badly needed for the good of the service.

We have been turned into this line of thought by the announcement that James McCrea, president of the Pennsylvania Railroad, has resigned and that M. E. Ingalls, chairman of the board of the Cleveland, Cincinnati, Chicago & St. Louis, has declined re-election. Both these gentlemen are still in what used to be considered the prime of life, Mr. McCrea being 64 years old and Mr. Ingalls 70. Both are still active and clear headed, with no indication of failing powers. Yet the example set by these representative railroad presidents is likely to exercise a good influence on railroad personal life, for it will indicate to many old stickers that to retire from active service makes no reflection upon the zeal of men grown gray in harness.

Erie Instruction Book In Japanese.

Through the Erie Railroad Employees' Magazine we learn that Mr. Luis Jackson, Erie's industrial commissioner, has been on a visit to Japan. While on the return voyage over the Pacific Mr. Jackson made the acquaintance of Mr. G. Shibo, of the Imperial Railways of Japan, an old subscriber of ours. On learning that Mr. Jackson was from the Erie Railroad Mr. Shibo said that he had just translated into Japanese the Erie Railroad Instruction Book called Good Firing, and a copy had been given to every engineer and fireman. For the Japanese enginemen the book is called Fuel Economy; How They Save Fuel on the Erie Railroad. The book was written by Angus Sinclair and is for sale under the name of Firing Locomotives. It may be added that the same book was translated some years ago in the Chinese language and has an extensive circulation among railway men in that country.

Air Brake Department

Main Reservoir Failures.

Some railroads have experienced considerable trouble from main reservoir failures in the way of reservoirs exploding when in service. The cause of the failure is generally attributed to defective metal thinned by corrosion or weakened by the action of gaseous matter, and we have had occasion to inspect several reservoirs that had exploded and have seen main reservoirs give away as well as air pumps, that is, have seen air pumps break loose from the pipes and brackets and fall to the ground. We were also quite well satisfied in our own mind that we knew the cause thereof as well as the cause of some exploded reservoirs. The main reservoir test, which may be either a hammer or hydrostatic test, is relied upon to show up a dangerous condition of the reservoir, and it results in the removal of reservoirs, that if continued in service would eventually fail, but in the aggregate, the test has about as much relation to a main reservoir explosion that the boiler test has to a locomotive boiler explosion.

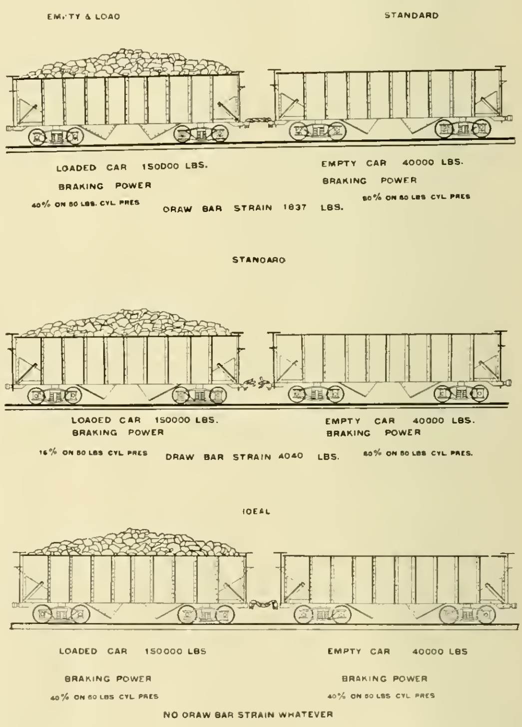
A new or thoroughly tested boiler may explode, and so may a new reservoir, and the writer has plugged and continued in service reservoirs that were less than 1/16 of an inch thick at the point it was plugged, the leakage past the plug, when but about one thread could be obtained in the reservoir, was stopped by pouring some cast-iron borings into the reservoir, the moisture would then corrode the particles of metal about the plug and prevent leakage. Further than this, the writer has no knowledge of any reservoir in this condition failing or exploding in service or at any other time, while reservoirs apparently in good condition have failed.

When corrosion or the action of gases reduces the thickness of the metal to 1-32 of an inch or less, a small hole or crack soon opens and shows leakage and sometimes this leakage is allowed to continue for a considerable time, but this does not necessarily result in an explosion, and we have our doubts as to whether it is ever possible to explode a reservoir with the standard air pressures carried, but an abnormal pressure is no doubt the cause of explosions rather than a thin or weakened reservoir. The results of some tests made indicate this, and the writer is convinced that where the use of engine oil in the air chamber is prevalent, or where large quantities of an inferior grade of oil are poured into the air strainer, deposits of sediment in the reservoirs and pipes make the explosion a possibility.

All air brake men know what is liable to happen if engine oil is poured into the strainer of an overheated air pump, and the same kind of an explosion is liable to be started in the main reservoir and burst it.

Having been employed by quite a number of railroads, we have observed that on one particular system, where a good grade of valve oil was used—in fact, it was sometimes used so extravagantly that from a pint to a quart of clear oil was at times drained from the main reservoir and used a second time—no main reservoir explosion was ever heard of during the 5 years of employment with that system; but, upon entering the service of another large road, was surprised to find that these main reservoir explosions were of common occurrence, and at times almost became an epidemic. At this same time it was observed that it was a general practice to use engine oil in the air cylinders of air pumps. However, it was not a practice sanctioned by the motive-power officials.

Granting the possibility of many things being coincident, it would nevertheless appear to be good policy to eliminate this undesirable and dangerous practice while attempts are made to overcome reservoir explosions by test.



GRAPHICAL ILLUSTRATION OF THE EFFECT OF DIFFERENT PERCENTAGE OF BRAKING POWER ON EMPTY AND LOADED CARS AS AFFECTING DRAW BAR STRAINS.

Empty and Load Brake Efficiency.

During the past year the air brake department of this magazine contained a number of articles leading up to a description of the "empty and load brake" for

freight cars. During the first months of the year, the handling of modern air brake equipment in both freight and passenger service was dealt with, particular attention having been paid to unequal braking effect, its causes, the resultant damage to draft gear and break in two of freight trains under modern operating conditions.

This was followed by articles entitled "Requisite Braking Power" and "Equipoise in Forces," which were intended to show the absolute necessity for a braking power for the load, as well as the empty car, after which the "empty and load brake" was described and illustrated.

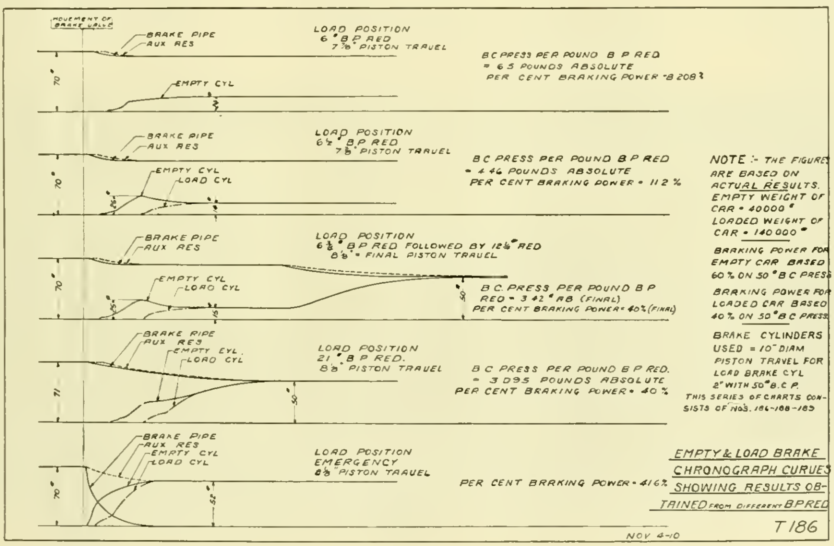
The drawings and diagrams in this issue illustrate more clearly than possibly any other method, save an actual demonstration, the efficiency of the empty and load brake for freight cars. In the brake, and the diagrams shown will require no particular explanation—the difference in draw-bar strain and its results are very clearly shown.

The chronograph chart shows the brake cylinder pressure and consequent braking power obtained from a number of different brake pipe reductions. These results are so clearly set forth that any explanation would be merely a repetition.

Defective Triple Valves.

An air brake man recently stated to us that during a certain period there were a specified number of cases of break-in-two of freight trains on the road with which he was connected, and requested our offhand opinion as to how many of those break-in-twos were due to defects in triple brakes have not been tested from the yard test plant, the locomotive will couple up, charge the train, and test the brakes. If the triple valves all work in service during the test, what defect of a triple valve that will cause undesired quick action, is liable to develop during the next reduction?

There is, of course, a possibility of the test being made before all the auxiliary reservoirs are fully charged, or an obstructed feed groove may prevent a defective brake from being charged, but outside of such a possibility as a piece of foreign matter lodging in the service port or a shower of scale or dirt from the brake pipe lodging about the piston and packing ring; there is but very little opportunity for a triple valve to pass the service test and then work quick action



EFFECT OF BRAKE PIPE REDUCTIONS, E. & L. BRAKE.

design illustrating the draw-bar strain between cars braked as shown, all conditions are taken to be equal except the load, the difference in draw-bar strain being produced by the effect of the load during the application of the brake. We have already explained that under present methods of designing the braking power to be used an empty car may have the same piston travel and brake cylinder pressure as a loaded car which may be a force, equal in pounds, to 60 per cent. or 70 per cent. of the weight of the empty car, while the other car loaded to three times its light weight may have a brake shoe pressure somewhat less than 20 per cent. of its total weight.

This condition and its obvious results is overcome by the empty and load valves. Knowing that all cleaned or repaired triple valves were tested on the standard rack for this purpose, we ventured that the number of cases might possibly run as high as 1 or 2 per cent. of the total number of break-in-twos. From the expression of his face we were led to believe that our humble opinion was not very highly appreciated, and we may be very much mistaken, but regarding this question from a triple valve point of view, the estimate may have been a trifle too high.

We also ventured to state that if the brake did not work quick-action on the first reduction, or rather the first application, there was but a very remote possibility of a triple valve causing undesired quick action thereafter.

A train of cars is made up, and if the upon the next service application. It is true that cases of undesired quick action develop en route, even upon the first reduction after the train gets in motion, but there is generally a very good cause for it and the source of the trouble can seldom be traced to any particular triple valve in the train. There are almost innumerable causes for undesired quick action, and probably one of the most prolific causes is merely a change in weather conditions, but it does not necessarily follow that the quick action will part the train, in fact if the train was parted every time the brake valve was used in emergency position, or every time an additional reduction through brake pipe leakage causes the quick action, some roads in the country would haul very little freight on account of most of their cars

being shopped for repairs. The sum and substance of the matter is that entirely too many broken trains that are caused by weak draft gear, careless use of the engine throttle, and thoughtless manipulation of the brake valve are blamed upon a "weak" triple valve, and it is almost needless to say that an abuse of release, lap, and service, as well as emergency position of the brake valve is prevalent to a great extent. In justice to the air brake it should be remembered that the train may part before quick action occurs and while investigating cases of trains parting, undesired quick action should not be too closely associated with broken couplings.

Replacing Valve Cages.

In our travels about engine houses and locomotive repair shops, we have observed that a large number of air pump air cylinders of both the 9½ and 11-inch pumps find a premature resting place in the scrap heap. There are various reasons for which these cylinders have been scrapped, but in the majority of cases it is due to badly worn or damaged threads in the discharge valve cavity. It is evident that at some stage of service a valve cage had been screwed in place without first truing up the threads in the cylinder with a tap.

In locomotive service the air cylinder of the pump is frequently under a very high temperature and at the end of the trip it is permitted to cool, and during the alternate heating and cooling the temperature lowers unevenly around valve cages, due to the fact that there is a considerable difference in the amount of metal surrounding it, and, as the outside portion has the lower temperature, the uneven reduction has a tendency to warp the valve cavity, not enough to be noticed with a pair of calipers, but nevertheless enough to have the cavity imperfect or out of round. For this reason the discharge valve cages are sometimes hard to remove, and it is often impossible to replace a new cage without first using a tap in the cylinder, but with the cylinders in question it is evident that attempts were made to renew cages without first using the tap. The result is that when the cage starts to turn hard, and is then forced into place, the least harm that can result is a worn or damaged thread, but frequently a piece of the cast iron thread imbeds itself in the brass cage and from then on all the threads are torn loose or broken out.

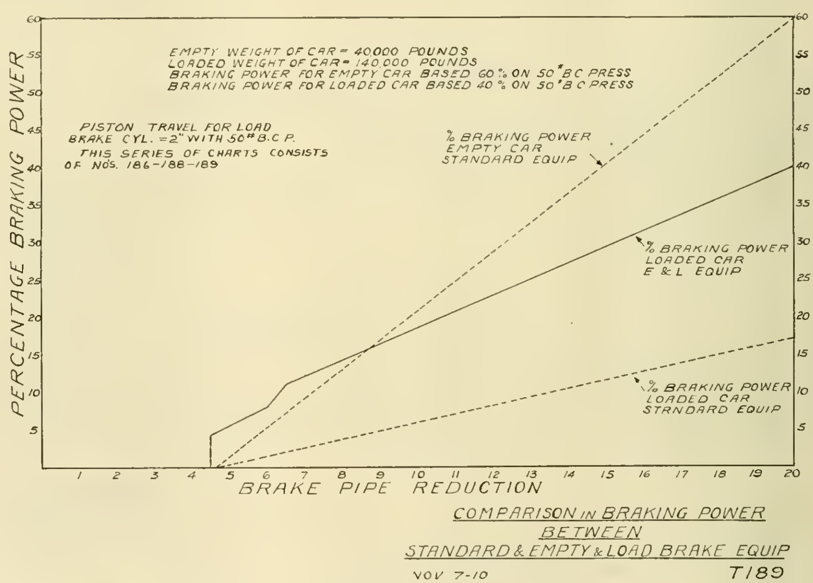
The condition of these threads is of utmost importance from a viewpoint of air pump efficiency, as leakage past them allows main reservoir pressure to flow back into the air cylinder, and when they are once damaged the cylinder soon finds its way to the scrap.

It is, of course, possible to use a larger tap and a size larger cage of special manufacture, but it is more convenient and less expensive to maintain the original size of thread, which can be successfully done if the repairmen follow an absolute rule never to screw a valve cage into the cylinder without first truing up the threads with the standard tap for this purpose. If this is done and the cage is then coated with a mixture of graphite or plumbago and oil, it is a reasonable preventative against the cage ever becoming stuck in the cylinder.

To coat the cap screws with the same fluid before screwing them into place, and to maintain the air cylinder in a reasonable state of efficiency will keep the damage to air cylinders to the minimum. All the threaded portions of the air cylinders of both the 9½ and 11-inch pumps are 12 per inch, the sizes being as follows:

9½-in. pump—
- Valve seat, 2 ins.
- Valve cage, 2⅛ ins.
- Valve cap, 2⅝ ins.

11-in. pump—
- Valve seat, 2⅛ ins.
- Valve cage, 2¾ ins.
- Valve cap, 3¼ ins.



Richard Newsam.

Mr. Richard Newsam, who for years has been president of the State Mining Board and manager of the revenue stations of the State of Illinois, has resigned. In accepting this resignation, Governor Deneen wrote: "I regret exceedingly that your health is such that you feel called upon to sever your connection with these important branches of the state work, in which you have served so long and favorably with efficiency." Mr. Newsam was the inventor of the one-shovel system of firing locomotives. He gave his services gratuitously to several railroad companies while he rode on the locomotive, instructing the firemen how to keep up a good head of steam and preventing smoke by following his system.

4-6-2 Type Locomotives for the Chicago & Alton Railroad

Among recent new locomotives it is interesting to learn of the very favorable reports being made on a new Pacific type furnished by the American Locomotive Company for the Chicago & Alton Railroad. As shown in the accompanying illustration, these locomotives are equipped with the Baker-Pilliod valve gear. This gearing is coming rapidly into use, and is meeting with general approval. In the present instance it is reported that after a period of the severest kind of service at the highest speeds the position of the valves, on examination, was found to be exactly as originally adjusted. Those who are familiar with the rapid variation incident to the use of the Stephenson gear in hard service will readily appreciate the record of the Baker gearing.

These engines were built in accordance with specifications furnished by the railway company, the engineers being guided by records carefully noted in locomotives of a similar type, and such parts as were subject to rapid deterioration have been strengthened, with the result that the type now being introduced is the outgrowth of experience and are unquestionably the best that can be produced for the service intended. The record of speed on the long level stretches between Chicago and St. Louis equal, and in some instances surpass, the best records of long distance running. There are now about 270 locomotives in service on the road, and the number is being constantly added to. These latest additions of the Pacific type are looked upon as the best in the service. The principal dimensions are as follows:

Gauge, 4 ft. 8½ ins.; cylinders, 23 ins. by 28 ins.

Driving Wheels—Diameter, 80 ins.

Boiler—Diameter, 72 ins.; pressure, 200 lbs.

Firebox—Length, 108 ins.; width, 66 ins.

Tubes—Number, 371; diameter, 2 ins.; length, 20 ft.

Wheel Base—Driving, 13 ft. 9ins.; engine, 34 ft. 8½ ins.; engine and tender, 66 ft. 4 ins.

Weight in Working Order—Leading wheels, 50,500 lbs.; driving, 149,500 lbs.; trailing, 48,000 lbs.; total engine, 248,000 lbs.; tender, 165,120 lbs.

Fuel—Soft coal.

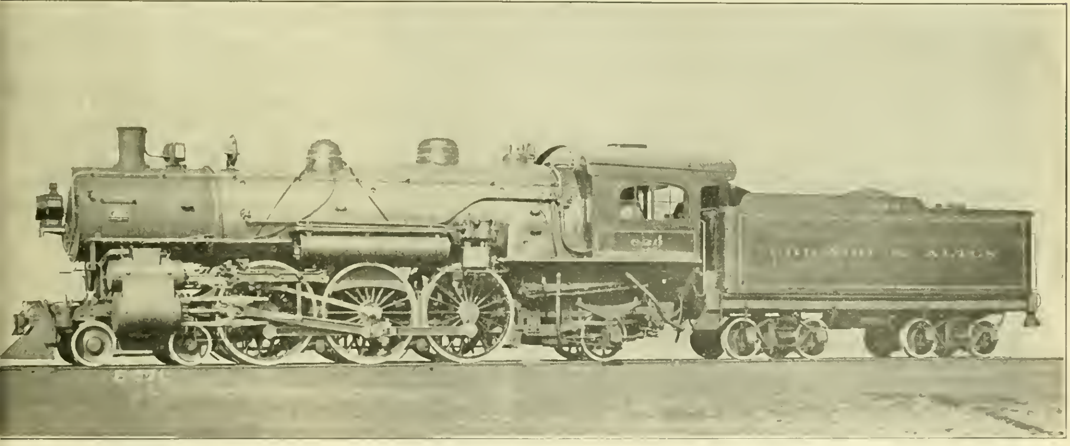
Heating Surface—Tubes, 3,888 ft.; fire box, 202 ft. Total, 4,090 ft.

Grate Area—49 ft. 6 ins.

Maximum Tractive Power—31,475 lbs.

Factor of Adhesion—4.75.

Tender—Type, 8 wheeled; capacity, 8,500 gals.; fuel, 14 tons.



PACIFIC TYPE OF LOCOMOTIVE FOR THE CHICAGO & ALTON RAILROAD.

J. T. McGrath, Superintendent of Rolling Stock. American Locomotive Company, Builders.

Substances That Attack Tin.

The popular idea that only acid substances attack tin is wrong, says the *Scientific American*. Fish, asparagus, beans, pumpkins and spinach are not acid and yet their corrosion of tin is quite marked. This is probably due to amino compounds, substances related to ammonia. In the case of shrimp the cans are often eaten through in a comparatively short time. So alkaline is the methylamine contained in the shrimp that workmen in the canneries find the skin peeling off their hands and their shoes eaten through. Shrewd observation by some canners led to the discovery that if the shrimp were iced for a day before canning the corrosive action of the juices was greatly diminished. This is now the universal practice. In addition the cans are lined with paper to prevent contact of shrimp and tin.

Roasted the Engineer.

There is some kind of fairness among most members of lawless gangs, but there seems to be a melancholy exception to this among certain ruffians in Mexico, who defy law as rebels and are a disgrace to humanity. One of the latest incidents of the cruel war was the capturing of a freight train by a band of Zapatists. There were few individuals upon whom the rebels could display their savage taste for cruelty, but they murdered the conductor and forced the engineer, while alive, into the firebox of the locomotive. There is talk of exterminating the reptiles composing the Zapatist bands who appear to be tempting that fate.

Detection Kodaks at Work.

Indications are that the Delaware, Lackawanna & Western Railroad management was in dead earnest when they promulgated Rule G, which prohibits employees from visiting drinking places even when off duty.

A detective has been sent out with a camera to take snapshots of people who violate Rule G. Two trainmen were snapped at Elmira while regailing themselves in a resort where liquid refreshments are sold, and the pictures were produced as evidence against them. One of the unfortunates is a veteran who would have been pensioned in a short time.

This is going it strong, but it is evident that the Lackawanna rules are not made to be laughed at.

Electrical Department

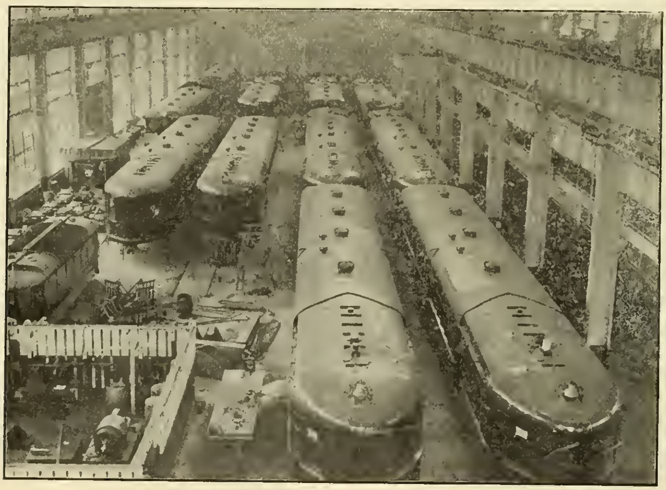
Gas-Electric Cars.

The operation of the gas-electric motor car in the railway field has been watched with intense interest by railway officials. It has opened up a means for applying "scientific management" to the operation of connecting divisions, and has offered an opportunity for more efficient operation of the supplementary service on railway systems. Through its adoption on branch steam roads the solution on an annoying problem in railroading has been solved.

With the growth of competition, how to make the short lines of the system running through territory not densely populated bear their proportionately lower share of the operating expenses and pay dividends, has demanded close study. Especially have railway companies been interested to observe the gas-electric car in action day in and day out under every traffic condition on local schedules. Reliability and low maintenance are as important as economical operation, and railway managers generally have been particularly anxious to ascertain from actual service performances how much more effectively this modern type of rolling stock, the gas-electric car, supplants the steam locomotive on branch lines.

Perhaps the best way to judge the performance of the gas-electric cars is to note their increasing use and popularity. At the present time, twenty-two railroads have self-propelled units of this type operating on regular local schedules. In nearly all these cases the cars are employed for branch line service, replacing steam trains, which in many instances were operated at a loss, due to local traffic conditions. A gas-electric car, operated as a train with a trailer and described in our last issue, is now being tried out for regular local train service and will be operated between the schedules of limited through trains on the main line four-track road of the Pittsburg & Lake Erie Railroad.

An analysis of the operation of these cars reveals some very interesting features. While the consumption of gasolene necessarily depends on the character of the traffic and roadbed, it has been demonstrated in practice that it averages exceptionally low; and this results from the principle of propulsion employed in the gas-electric car. An electric generator, coupled directly to the gas engine supplies current to the motors mounted on the axles so that by this application of electric transmission, rapid acceleration and flexibility of operation are obtained by varying the strength of the generator field, without loss of power in a resistance or gear changes. Through this method of control, full utilization of the power input is secured throughout the entire speed range, from start to full speed.



GAS-ELECTRIC MOTOR CARS UNDER CONSTRUCTION.

The experiences of railroads using gas-electric cars has now been sufficiently extensive to establish their salient points of advantage under diversified service conditions. Wherever these cars have been adopted, very marked twofold benefits have resulted. Not only have the cars proved reliable and economical to operate, but the development of new business has been particularly noticeable. The transportation costs per passenger have been appreciably reduced, and traffic has been greatly stimulated through the readiness of the public to take advantage of the more frequent and convenient schedules possible, and the increased pleasure of riding in rapid transit cars with the comforts of Pullman service and the cleanliness of electric railway travel.

The illustration shows fourteen gas-electric cars under process of construction, a short time ago, in the Erie shops of the General Electric Company. Among these are cars being built for the Missouri & North Arkansas, Texas Midland, Pittsburg & Lake Erie, Rock Island and 'Frisco System railways. One of the most significant tendencies in connection with the introduction of gas-electric cars is exemplified in the fact that 40 per cent. of the roads on which they are operated, have subsequently installed additional cars. Among the largest users of gas-electric cars is the 'Frisco System, which now has seventeen of these self-propelled units running regularly on branch lines.

Storage Batteries.

We commenced in our last issue the description of the lead storage battery, pointing out that the accumulation of electric power in the battery was due to a

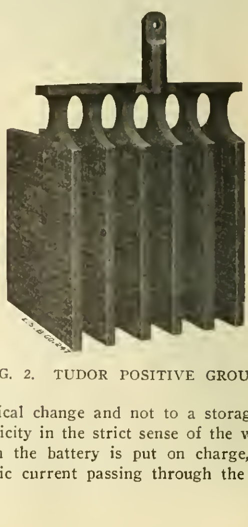


FIG. 2. TUDOR POSITIVE GROUP.

chemical change and not to a storage of electricity in the strict sense of the word. When the battery is put on charge, the electric current passing through the bat-

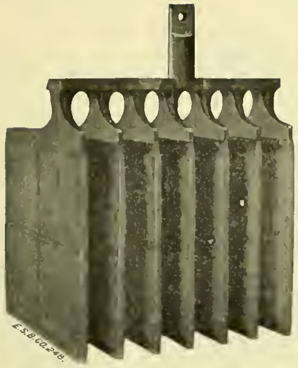


FIG. 3. ROLLED NEGATIVE GROUP.

tery causes a change in the lead plates. This chemical change remains in this condition until the terminals of the battery are connected to motors, lamps, etc., when an electric current will flow from the battery due to the force which exists for the plates to return chemically to their original condition.

Storage or secondary batteries, as they are sometimes called, can be divided into two kinds, according to the process of manufacture of the lead plates, commonly known as the Planté and Faure types. In the former the pure lead plates, are formed by repeated charging and discharging, until the surface of the plates become porous or spongy for a considerable depth. The plates are designed to present large surface area to the action of the electrolyte (the solution in which the plates are immersed). In the latter, or Faure type, the active material is formed and placed or "pasted" on the plates before they are placed into the electrolyte. In this type the frame is usually of a lead alloy for strength only. Figs. 2 to 5 show various types of both positive and negative plates which are manufactured by the Electric Storage Battery Company of Philadelphia for car lighting service.

Figs. 2, 3 and 4 illustrate the first or Planté type. The positive plates of lead are brown in color. A large surface area exists. The negative plate is gray in color, and in order to present a large surface for the formation of the pure lead, which is porous or spongy, the plates are rolled with knife contacts so that the lead is expanded into thin strips, and the plate has the appearance of strips of paper on edge. Fig. 2 shows this condition, and it is also to be noted that the plates are much thicker at the rolled spots, due to the expansion of the lead.

Fig. 5 show the Faure type with the active material "pasted" into lead alloy frames. The positive plate, Fig. 4, known as the Manchester is made up of "buttons." These buttons are rolls of retaining frame by hydraulic pressure. As these "buttons" expand on the charging the chances of loosening are very slight. In the pasted negative the pure lead is worked into the spaces in the lead alloy frame.

Each of the cuts shows what is known as a group, i. e., several plates connected lead ribbon forced into the holes in the together. Referring to Fig. 2 each plate P before assembly, includes the lug L, in other words the lug is part of the plate. The strap S is of moulded lead having rectangular openings into which the lugs are "burned." The "burning" is done with an oxygen-hydrogen blowpipe with very fine flame. The lead is melted at the point where the joining is to be made, and stick lead is run in, forming a "puddle" which when allowed to cool forms a perfect solid joint.

In assembling the plates in the jars separators are placed between the positive and negative plates to keep them out

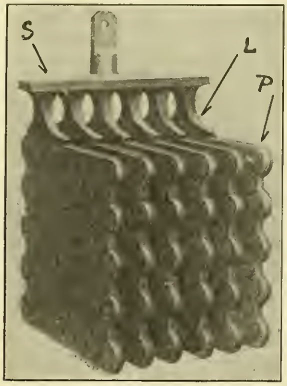


FIG. 4. MANCHESTER POSITIVE GROUP.

of contact. There are two types used by the Electric Storage Battery Co., perforated hard rubber and specially treated wooden separators. The plates to go into one jar should be assembled on a bench or table, the separators put into place, and then the whole placed in the jar. Afterwards the electrolyte is added and the jars should be filled so that the top of the plates are covered with the solution by not less than one inch. The electrolytic is dilute sulphuric acid, and should be of approximately 1.22 specific gravity. The cells should now be connected together in series, the positive of one battery to negative of the next and an electric current passed through equal to the rate of discharge, and this charge should be continued until the specific gravity and the voltage of each cell show no further rise or increase and gas is being freely given off from all the plates. Thirty-five to forty hours of continuous time will be required for this initial charge. After this first charge the amount of charging depends on the amount of use the battery is put to and care should be used not to overcharge the battery greatly, as the life of the battery will be shortened. Occasionally, perhaps once a month it is well to charge the battery until "gasing" occurs.

RESISTANCE.

(226). I. R. B., Altoona, Pa., writes: What is the total resistance of two known resistances connected in parallel? A.—The total resistance will be less than either of the single resistances and can be obtained thus:

R (total resistance)

$$= \frac{1}{\frac{1}{r_1} + \frac{1}{r_2}}.$$

Take for instance two resistances of 6 and 8 ohms,

$$R \; \frac{1}{\frac{1}{6} + \frac{1}{8}} = 3.43 \text{ ohms.}$$

This same formula holds for any number of resistances in parallel and in the denominator there should be as many terms as there are resistances in parallel.

DIELECTRIC STRENGTH.

(227). J. L. M., Boston, writes: What do you mean by the dielectric strength of an insulating substance? A.—The dielectric strength is the voltage it will stand without being punctured. It is determined by placing a thin layer of the material between two metal electrodes and raising the voltage on these electrodes until a spark jumps between them through the material. This voltage is termed as the dielectric strength, and it varies greatly according to the material.

To Study Electric Engines.

The Pennsylvania has arranged to give any employee in its service a gratuitous course in electrical engineering and a large number have made known their intention to avail themselves of the opportunity to become familiar with the method by which many of the company's passenger engines are operated.

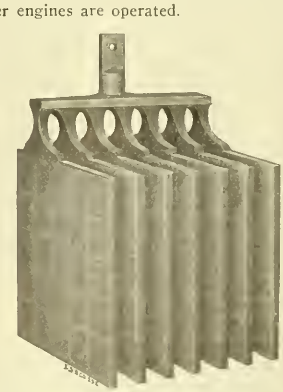


FIG. 5. BOX NEGATIVE GROUP.

The Evolution of Transportation

By W. N. MITCHELL.

PART III.

The locomotive is still in process of evolution, although it would seem that in many respects, both as to weight and tractive power, the highest limit has been very closely approached. The locomotive is not by any means an economical machine, owing to the service expected and the conditions under which it must operate; yet as a machine it has steadily increased in efficiency ever since the little "Tom Thumb" wound around the curves of the Maryland hills.

There were various kinds of innocent enjoyment derived from traveling in the ways used by our grandfathers. Even though we have robbed travel of some of its dangers and terrors, and have contributed to the advance of transportation, we must look back with regret at some of the joys which were no doubt an accompaniment of trips made in the early stages of coaching days. There must have been a greater thrill of excitement and interest pervade the atmosphere of the old stage coach when an eloping couple hastily sought refuge therein in the effort to escape a pursuing sire, than such an incident could create nowadays in the modern railway coach. Dr. Johnson used to say there were worse things could happen to a man than being shut up in the old stage coach with a pretty girl. Nevertheless, we cannot overlook the perils, inconveniences, and uncertainties of travel in those days, and feel thankful that they are passed. Hours of dreary waiting at roadsides, long cold rides with little or no protection in stormy weather, the absence of facilities for sleep and rest, the breakdowns caused by bad roads; the perils of holdups and such enlivening incidents; exposure to all kinds of weather, trying in vain to find a soft seat and to endure long and wretched winter nights, half starved and cold, were some of the penalties. Even if one were fortunate enough to secure a seat on the inside of the stage coach, cramped limbs could not be extended, no change of position could be obtained that would afford rest or comfort. The inexperienced, intoxicated, or careless driver had little thought of the consequences of which he might be the cause. Charles Dickens once said that he had been upset in every kind of a vehicle known.

What a wonderful step in advance it was when even the crudest passenger coach, drawn by steampower, replaced the horse-drawn stage coach. The cars were lighted; that is, candles were burning in them. What difference did it make that the cars were without heat, without brakes, without means of signaling the engineer, without any of the safety appliances that now are not only convenient but absolutely essential to the safety and comfort of modern travel. They were such a step in advance of the first coaches that their deficiencies were inconspicuous.

The tallow dip was replaced by the smoking kerosene lamp; coal-burning stoves were placed in passenger coaches and at times provided some warmth. The smoking kerosene lamp was replaced by electric light. The changes have been so rapid we are continually asking, "What next?"

As to the further evolution of transportation, who can predict what the future has in store? The steam engine has been responsible for the invention of other types of motors which in various fields are more efficient than any other form. Electrical developments seem to forecast impending changes in railway locomotion. Already huge and powerful electric locomotives are doing efficient service throughout extensive zones. Within a few years astounding feats in aerial flight have been performed. In the face of what has been done, it certainly is risky to assert that any one thing cannot be done.

It would seem as if the present steam locomotive had reached the economical limit of weight and tractive power; to increase weight beyond the present-day standards would necessitate a reconstruction of practically all railway track and bridges within the United States. Yet no one can foretell what the mind of man will do within the next few years to further the evolution of transportation.

We know that whatever is to come will be better than what has passed; that travel will be made easier and safer, and that as we are inclined to view the efforts of our inventor ancestors with scorn, our descendants will look back at our day and age and pity us for the little we knew and the little we did.

Let us measure up the results of the evolution of transportation. Almost every step that has marked progress or advancement in the world's history has been met with the fiercest opposition. It seems that not many of us are so constituted as to realize the far-reaching benefits likely to be derived from the efforts of those engaged in research and invention. We are inclined to fight or otherwise oppose innovation.

The early "mule skinners," who at one time had the freighting business in their control, bitterly fought the development of other transportation facilities on the ground that such development was putting them out of business or would ruin the business of the country generally. None of them had foresight to realize that although temporary paralysis resulted in the parent industry, the child of that industry would grow and create a demand for more human beings to carry it on than were necessary under the old order—that the process of evolution would work out a wider field for an increased number of men at a far better form of employment. They soon found it possible to secure easier work at better pay on the canals.

The development of transportation along every line created new industries which opened new fields and extended the old ones into fields of greater and wider activity. Wherever the canal followed the "mule skinner's" trail it put him out of the business of "mule skinning," but set him and his brothers at constructing the canals and the boats which were operated on them.

The railroads caused the decline of canal transportation, put many canals out of business. In similar manner, though with more far-reaching results, they created the iron and steel industries. They caused coal mines to be opened, built foundries and rolling mills, were the first to create an unprecedented demand for skilled mechanics. For every single man displaced through the result of changed transportation methods from stage coach to canal, from canal to railway, the number of men required to meet the changed conditions was increased many-fold. Not only has the number of employees called for by the evolution of transportation been increased but the working plane of each and every one of these men has been correspondingly raised.

One has but to review a list of manufacturers engaged at the present day in producing products allied with the equipment of railways to realize that probably in no other field of industry are so many men or millions of dollars of capital involved as in the railway supply business.

The hundreds of devices which are produced by the industries manufacturing railway supplies have almost without exception had for their object, increasing the safety of railroading and reducing the labor of railroad men. Take, for instance, the air brake, automatic couplers and injectors. Not

only have these three appliances increased the safety of railroading and reduced the labor of railroad men, but they have resulted in the development of industries employing thousands of skilled artisans and have created fields for inventive ability.

The brakeman has not been dispensed with through the introduction of air brakes or automatic coupling devices. He works fewer hours among fewer elements of danger at less arduous work than in the old days, and gets more pay. It is true that he is worth more. He is a man of broader knowledge than were those following similar employment in the early days of railroading. He has greater opportunities ahead of him. There are hundreds of positions to which he may aspire for which he may fit himself.

Such statistics as are available show a wonderful increase in the percentage of men employed in the various branches of transportation enterprises based on the population of the country now as compared with the percentage so employed twenty years ago.

While the Nineteenth Century went down into history as a record breaker in the field of invention, the Twentieth Century will undoubtedly eclipse it.

Every successful invention brings into existence an industry requiring artisans for whom there was no previous need. Had ignorance held full sway, the evolution of transportation would not have been written. This brings us face to face with present-day conditions.

Never was labor so well paid, so well treated and so comfortably provided for as at the present time. All the conditions of comfort and safety which were lacking in the early days of railroading have been anticipated and supplied. Upon no other industry is the prosperity of the country so dependent. In no other industry is the field for advancement and the reward for concentrated application greater. In this field, captains of industry are needed and in this field they are made.

The modern railway and its appurtenances have reached such a high state of development that in every department of its operation only the most skilled and proficient in their particular line can follow the pace which has been set. The proficient locomotive firemen and engineers of today are men who know something worth while. They are in charge of machines which to successfully operate, call for the exercise of both technical and practical knowledge. Every railway employee must study his work if he desires advancement. Only the poorly paid places are nowadays open to the uneducated man. The old methods of picking it up no longer avail. Definite systematic study is now necessary to a mastery of railroading, and the men who soonest realize this are the ones soonest selected for promotion. There is always room at the top for men of ability and special training.

Nearly every man takes two steps that have perhaps greater bearing on his life than any others he may take from childhood to his last days. At some time or other, he decides by what means he shall earn a living. That is one important step, but it is not half so important as the step he takes when he decides how he shall prepare himself to earn a living. His success is measured by both decisions, but it is the degree in which he prepares himself for his chosen work that is the determining factor.

The attainment of success, and by that is meant the gaining of a responsible position in life, providing a generous income, is seldom a matter of mere luck. The successful man of today is he who in the past prepared himself to seize opportunities as they presented themselves. His success is the result of forethought and deliberation. He has considered carefully what would be the most favorable and congenial road to success for him and has devoted his best energies in that direction. The real secret of success lies in being prepared for opportunity.

Westinghouse Air Brake Employees' Reunion.

The officials and veterans belonging to the Westinghouse Air Brake Company held a grand reunion at Wilmerding, Pa., last month. George and his brother Herman were present and helped to inspire life into the proceedings. The meeting marked the eleventh reunion of the Airbrake Veteran Employees' Association and was a formal uniting of the men who have borne the heat and burden of making the air brake works successful.

Christopher Horrocksburgen, of Wilmerding, was the oldest man in point of service present having been with the Westinghouse Company the entire time. His son, Victor E. Horricks, has served 21 years with the plant.

High officials were present, which personnel included John F. Miller, also a vice-president; Superintendent Sleeth, of the foundry; Superintendent Lytle, of the air brake department; General Superintendent O. W. Bunting, General Manager H. L. Humphries, Engineer Turner, Treasurer Emery and Col. H. G. Prout, of the Union Switch and Signal Company.

As toastmaster Edward A. Craig, southwestern manager of the air brake company and a veteran with a quarter of a century of service, officiated. President Richard Esler welcomed the guests, assisted by a reception committee, of which John Schuetz was chairman. Over 150 were present.

Since the association was organized 11 years ago, 36 members have died. Nineteen have retired, having reached the age of 70, when they are eligible to a pension under the system inaugurated personally by Mr. Westinghouse about four years ago. More unique, every member of the association represents a continuous service of 21 years or more.

Railway President Instructing Farmers.

"The Elimination of Waste Between the Farmer and the Consumer" was the subject of a most edifying address recently delivered by Mr. B. F. Yoakum, chairman of the Board of Directors of the St. Louis & San Francisco Railroad. Mr. Yoakum has taken a lead in promoting the interest of farmers, recognizing that prosperity of farmers and paying business for railroads go hand in hand. It is a pity that more of our railroad magnets fail to imitate the progressive policy of Mr. Yoakum—there would not be so much fault finding about railroads among the rural population.

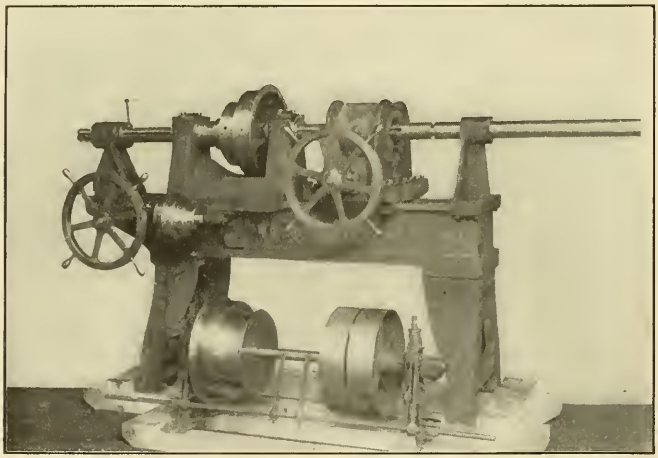
Cure for Laziness.

A French scientist has discovered that a hypodermic injection of formic acid will cure the most obstinate case of laziness on record. Experiments have been made in France which have proved this conclusively. A tired type of Parisian hobo was the subject of an experiment. A few drops of formic acid were injected into his vaccination mark. The tramp cut and split four cords of wood that afternoon, and when night came he refused to stop work, but was forced to. He was so enthusiastic that he sat up most of the night waiting for morning that he might again hie himself to the woodpile and wrestle with the axe. Another subject for experiment was a Paris "copper." With a few drops of formic acid in his system the officer actually covered his beat once during the day. Those who watched the experiment say that not once while on duty did he fall asleep. One more experiment was made, on a messenger boy, who wore out two pairs of shoes in three hours delivering messages, and when his day's work was done pleaded to be permitted to work all night. Formic acid hasn't yet been tried on the woman who dallies to get her hat on straight, nor on slow trains nor on Christmas shoppers, but we are now only in the infantile experimental stage with this wonderful "get busy." If a supply could only be brought to America and applied to tariff reformers and other political curiosities some real reform might be accomplished.

Armature and Axle Bearing Boring Machine.

H. B. Underwood & Company, Philadelphia, has introduced a new machine designed for boring the babbitted bearings of axles and shafts used in electric car service. It will be readily seen however, that its field of service is not restricted, as an endless variety of bearings can be bored equally as well. Its chief advantages are greater rapidity, complete adaptability and the quality of operation by unskilled help.

The hand wheel toward the right operates a powerful self-centering chuck which holds and centers split or round bearings in correct alignment with the boring bar. No skill is required to do this accurately and quickly. The jaws of the chuck will take bearings from 4-in. to 12-in. outside diameter. The cutting tool is held directly in the bar and the latter is amply strong to bore with a single ended cutter. In order that extremely accurate boring may be done on bearings of harder material than babbitt, an outboard support and extension bar are provided.



ARMATURE AND AXLE BEARING BORING MACHINE.

We do not know of any machine that will chuck and bore a split box in equal time. A recent test developed the fact that a split bearing, babbitt lined, 5 ins. in diameter, by 11 ins. in length of bearing, was bored out in less than one minute.

Market for American Manufactures.

In studying the market for American goods in Sweden, says the U. S. Consular Reports, two things must always be borne in mind—first, the demand for manufactured goods, and, second, the demand for raw materials that Sweden needs for its factories, to which may be added the demand for certain foodstuffs.

The field for American manufactured goods in Sweden is limited. The population numbers about 5,500,000, and it is the policy of the government to make the country as independent as possible of foreign countries for manufactures.

There are about 1,500 factories in Sweden producing machinery, which give employment to about 60,000 workmen and have an annual output valued at $53,600,000. They include many kinds of establishments, from the large iron and steel works down to the small factory making watches and clocks. Including the few large shipbuilding plants, there are about 75 concerns building vessels and boats of various sizes. However, Sweden is still dependent upon England for the construction of ocean-going steamers, and orders placed in Glasgow each year amount to fully $1,000,000.

Sweden imports annually from the United States machinery of all kinds to the value of about $1,200,000, and in all probability the American manufacturer will be able to retain this trade for some time at least, as the implements referred to are for the most part specialties. One American concern that manufactures harvesting machinery has established a branch factory in Sweden and this will of course lessen imports in that line. As a matter of curiosity it may be noted that several thousand dollars' worth of scythes are sent from this consular district every year to farmers in Minnesota.

To supply the demand for country vehicles of all descriptions there are in Sweden 60 factories, furnishing employment to about 3,000 laborers. Hence there is scarcely a market in this country for this line of manufactures. There is only one automobile factory, thus rendering the demand for foreign-made motor cars rather extensive, and in this respect prospects for American automobiles are very bright. There is a good market for low-priced, strong, well-finished American cars, many of which are already in use. During the last two years the American automobile has been steadily replacing those made in France and other European countries.

Rebating.

Officials of the New York Central Lines, which embrace the Lake Shore, the Big Four and others, in connection with the O'Gara Coal Company, have been made subjects of indictments by the Federal Grand Jury on the charge of rebating. Rebating has done more to make railroads unpopular with the public than any other form of dishonesty, and we hope that grim examples will be made in this case. Rebating of railroad rates is a form of cheating that the parties engaged in manage to call by some other less opprobrious name, just as travelers who cheat the people of the United States by smuggling manage to excuse their consciences with the claim that their crimes are no real cheating. The railroad official who habitually charges A fifty per cent more than he charges X for performing the same services, is stealing so much from A, a fact which is good law and good morality. Let no rascal escape.

Mechanical Engineers' Outing.

The American Society of Mechanical Engineers which is composed largely of manufacturers, has adopted the practice of visiting foreign countries to secure direct information concerning methods of doing work. Two years ago they held meetings in Britain, and now they are arranging to meet in Germany next year. The Verein Deutsche Ingenieùre, a society of German engineers, will accompany the American mechanical engineers on their arrival to the most interesting establishments as viewed from the manufacturers' standpoint.

Conrad Matchoss, of the Royal Polytechnic High School, in Berlin, is now in this city conferring with representatives of the American society as to the details of the trip.

The tour will include visits to all the principal cities and industrial centers of Germany. The trip and the various official receptions are being arranged by a committee of the most important men of the arts and sciences in the German society, and there is the keenest interest shown by municipal authorities and the heads of industrial establishments.

The final meeting will be held in Munich, on July 7, in connection with the Museum of Technical Arts, of which Dr. von Miller is the director. It is expected that the Prince of Bavaria and the Mayor of Munich will receive the party.

These outings have become of much real importance, and in some departments of engineering work, they are rapidly becoming a real necessity and should be taken full advantage of.

The Dynamometer Car

Tonnage Ratings and Resistance

The Pennsylvania Railroad was the first in the use of the Dynamometer, or Dynagraph, car. It is a device for measuring the force exerted in overcoming resistance. It also records the distance and time required to accomplish certain results. Properly speaking, it indicates the first of these items, but it may be so arranged as to show both of the others. A traction dynamometer may be interposed between any load to be moved and the engine or motor exerting the traction force. It is usually a spring balance or hydraulic cylinder, with a graduated scale attached, showing the number of pounds required to haul a train, and also attached means showing the speed and location of the train.

In recent service a test car, as it is called, resembles a trainman's caboose. An upper compartment is fitted for the recording machines, and there is ample opportunity for observation both front and rear, as well as on the sides, to observe signals, mile posts and other appliances. The main floor of the car is the storage and living compartments, including retiring and dining rooms, kitchen and other rooms.

On the coupling connected with the dynamometer draft cylinder there are six pairs of rollers, three pairs on each side of carriage, which carries draw-head. The particular office of these rollers is to minimize the fractional resistance of engine hauling her train. In cold weather the car is heated by the Baker Heater System, located at back end of car, and pipes leading around car, with special coils around hydraulic cylinder to keep the oil in cylinder from getting sluggish and thick. When on test trains the car is coupled on the head end, directly behind the tender of engine, so as to have full strain or pull from engine on the hydraulic drawbar of car.

The drawbar is secured by a suitable piston-rod, connected to a piston-head, which fits closely in the hydraulic cylinder filled with oil, the pull of the locomotive at the drawbar thereby produces a pressure upon the oil, which is transmitted through an arrangement piping, leading up into two small pressure cylinders in the cupola. Between these cylinders is a cross-head connected with springs of known strength, so that a given pressure in the cylinder may be measured by the extent of travel of the pistons in the small cylinders. The motion of this cross-head is communicated to a pen by means of a pentograph motion, so that a pull of 10,000 pounds will move the pen one inch.

The area of hydraulic cylinder is 201 square inches. Area of front end, minus the piston rod, which is four inches, 188.49 square inches; area of pressure cylinders on pentagraph, .5 square inch. The width of the paper used is 12 inches and is called No. 1 drug and is giving very good service. The record paper is driven past the pens, recording on the table at the rate of 16 inches to the mile and by mark on rollers can tell exactly when mile posts are coming. The mechanism for revolving paper on dynamometer table is taken from axle and is reduced in speed in turn by gears and travels over the table in such a manner that it passes from large roll behind table, across the table, under recording pens and down around two brass rollers and winds on another large roller, and at end of trip the record is rewound from roller by means of a split removable roller that fastens on the table suitable for this convenience.

The recording pens, all of which are the stylographic type, are set in such a position that the height of the record from the base line is proportional to the drawbar pull in pounds. The speed line is after the same principle, only that every 1-32 of an inch from base line represents one mile. The location pencil is set at any convenient spot as long as it is out of the way from the working of the other pencils. This pencil is connected by a storage battery, and attached to an electric telegraph sounder, with push buttons situated at convenient places around car for the record of mile posts, stations, etc.

At the time of passing these places, by pushing the button it at once records on the record paper, by making a connection at sounder, drawing pencil over about 3-16 of an inch, making this amount of variation on the location line, the operator will mark number of mile posts, name of station, time of passing, stopping or starting, opposite these marks. A Boyer speed recorder is used, and is placed on left of table, while its operating parts are enclosed in an iron case fixed upon the dynamometer table. The other devices used during tests are an anemometer, for recording the relative velocity of the wind, and a weather vane, showing the direction of the wind relative to the direction of the car.

Small pumps are attached with piping for circulating the oil, filling and discharging the cylinder and adjusting the position of the hydraulic piston, while the location of the valves and connections indicates the range of its possibilities. The hydrostatic gauge shows in pounds per square inch and is further calibrated to indicate clearly the drawbar pull. Vent valves are provided underneath the machine, near floor, to discharge the air which leaks into the system; also a small leak in pressure cylinders for the same purpose, which allows oil to flow into oil groove, which is provided for this purpose, down through suitable pipe into a small reservoir, which is drained at will of operator. The leakage of oil through these parts and hydraulic head are surprisingly small, as oil is only to be supplied to the main cylinder once in two hundred miles.

A reservoir containing oil is conveniently located to replace any oil that may leak from system through the numerous pipe joints. The pipes lead directly to pressure cylinders from front and back of cylinder, while a separate piping is arranged to adjust hydraulic piston. The dynamometer cylinders are made of cast-iron, held together to steel frame of car by studs and bolts. The piston-rod is connected to the drawbar by means of a steel block and key, as shown by sketch (Fig. 2). The stuffing box is packed by six leather rings and kept in place by cast-iron gland held in by four studs.

The oil used during tests is called dynamo oil, which has just enough body to keep the oil from passing piston-head and also very satisfactory in cold weather from keeping the oil getting thick and sluggish. Upon the front of the car is located the air brake gauges, showing train line, air brake cylinder, auxiliary reservoir and signal system; also an air brake recording device.

The working force during tests are one operator, one engine observer, one traveling engineer, and one trainmaster. The duties of the operator are to record all locations and time of passing or stopping at stations, etc., recording mile posts, noting drawbar pulls, speed going up grades, keeping a careful check on all tonnage of train at all times. Before test started he arranges a list in train order, showing actual scaled weight of cars on train, and is prepared to give the reduced tonnage corresponding with any cut, figuring out all resistances and reports. He also keeps the superintendent of motive power advised as to the movements of car, whether in testing or deadhead movement; also to note any improvements which may be necessary on the car or in getting tonnage over the road.

The duties of the engine observer are to report to operator, through ½-inch rubber hose, which is connected from car to engineer's seat, with whistles on each end for the convenience of calling each other when necessary, all changes in the position of the throttle; steam pressure and reverse lever in quadrant; also the using of sand or anything in working of the engine, together with measurements of water and coal consumed, and to make copies of test reports to be sent to railway officials, including general manager, superintendent of motive power, general superintendent, superintendent of division and master mechanic.

The duties of the traveling engineer are to see that the maximum performance was obtained from the locomotives at all times, especially going up grades, and to see that all parts and connections were in working order and that engine had a full head of steam. The traveling engineer was, therefore, made responsible for the performance of the locomotive.

The duties of the trainmaster are to see that the car or train is kept on the move, and to notice brakes on tail-end at times; also to run things in general around the train and issuing instructions to have car handled carefully at terminal points, etc., and particularly watch the performance of locomotive in handling test train compared with old rating and rating suggested by operator, for great care and judgment should be exercised by those on the test, so as not to overload the engine at any point, for the intention of railroad officials to haul heavy loads has become so pronounced and so well known that in many cases they have overshot the mark, and have been putting behind their engines the heaviest loads they could get over their division, with some corresponding loss in a great many ways.

In preparing a test train the trainmaster has orders from his superintendent regarding a maximum tonnage, or a rate he thinks they can handle over the ruling grade, etc. The yardmaster has train switched accordingly; also gave scale weight tickets to operator and checked train for his own information, getting a form from yard office and making an extra one for himself. The train started out, usually an extra, and all observations taken from beginning by operator, such as temperature, speed of wind from anemometer, also direction of wind in relation to car, noting also water and coal on tender, diameter of driving wheels and anything which may serve as a record. In the mountains a special engine followed the train with extra cars as safety would permit, for the purpose of assisting in any back up movements when stalling, or failing to make the next station in time for a meet on any special train.

In arriving at the tractive effort at the drivers from the dynamometer, we must find the resistance of the train in pounds per ton. Taking an actual experience we recall an engine with the mileage point at 26.3 per hour, developing a drawbar pull of 25,000 lbs., and a load of 1,792 tons, thus showing a resistance of 14 pounds per ton. This amount of resistance and tractive effort diminished as the speed increases until the train has reached a high velocity or is passing over a grade, when the decrease of tractive power is very rapid.

In rating any division of the road it was necessary to make use of only one or two locomotives, as it would take a considerable length of time to test every engine running out of a terminal, and as all engines are considered proportionate, it was only necessary to use formula to calculate load for any per cent. of engine and to illustrate this a proportionate tonnage may be used. This form is for use of yardmaster and trainmen and others concerned in making up trains at terminals, or at changing points along a division.

In computing the element of resistance in addition to the drawbar pull, there is the amount of work absorbed in internal friction, including rolling and journal friction of engine. This depends partly upon wind and curve, and upon rigidity of rail.

Work absorbed in rolling and journal friction of tender. Work of overcoming air resistance of locomotive. Work of overcoming grade resistance for weight of engine alone. Work of accelerating engine and tender.

In regard to train resistance there are the elements of work absorbed in rolling and journal friction of train depends upon wind, curve and rigidity of rail; work absorbed in journal friction of train; work in overcoming air resistance of train, and work of overcoming grade resistance for weight of train alone; work of accelerating train.

The effect of head winds is to increase the air pressure, as we all know, they may be approximated by adding to the velocity of the train, the velocity of the wind and using this figure instead of the speed of the train in determining the head air pressure. For example: If a train is running 60 m. p. h. and there is a head wind of 30 m. p. h., it is evident that the air pressure will equal 90 m. p. h. The most noticeable effect of heavy winds on train resistance, however, are when they strike at quartering, the effect is that the grade side of the train presents a much greater surface to the action of the wind, and it is probable that quartering wind striking the train at an angle of 45 degs. makes the maximum combination possible of air resistance, because it is combined—the effects of partial head air resistance and the action of the wind upon the broadside of the train in forcing the flange of the wheels against the opposite rails.

There is not much difference in the resistance between 10 to 30 m. p. h. In explanation of this, it may be stated that the journal friction is greatest at the start, rapidly decreasing after once started, and then gradually decreasing to approximately 20 to 30 m. p. h., reaching its minimum in the neighborhood of these figures, and then afterwards being constant, are slightly increasing for higher speeds and then decreasing again at 50 or 60 m. p. h., and about 90 to 100 m. p. h. the entire energy of the locomotive is absorbed in itself and tender.

On these tests the resistances were shown to be very slightly greater than in summer time, when the train was fairly started, but in starting a train, especially after it has been standing for some time, and allowing the boxes to freeze up, etc., the effect of the lower temperature is most noticeable.

Switch Tower Man Becomes Writer.

That manual employment need not be intellectually stifling is seen in the experience of James O. Fagan, who worked in the railroad service for 30 years and then became a successful author. He says that when he was on duty in the switch tower, his inner life, the things he was reading and thinking of were like a singing within him, while he was yet instantly alert and ready with every mechanical task. He describes in the *Atlantic* the process by which he taught himself to write, saying:

To begin with, I simply went to work to practice the arts of condensation and clearness of presentation for their own sakes. The simple satisfaction of being able to put into words what I saw with my eyes, and fancied in my mind, was sufficient reward for the exertion it entailed. And I was assisted in my efforts at the time by a very commonplace incident. Shortly after my return to the switch tower, I wrote a short story on some railroad subject and sent it to a publisher in Boston. It was returned without comment. I then sent the same article by way of a friend to another publisher, and the verdict from him was somewhat as follows: "If the man is a switchman, in all frankness I say, let him stick to his job."

I took the advice in good part and immediately went to work on plans for improvement. I took Shakespeare's play "The Tempest" as a sort of model with which to experiment, I studied the plot, the characters, and the scenes. When thoroughly familiar with these features I proceeded to write the story in my own words, being careful to leave nothing out, and weaving the whole into a straightforward narrative, containing about 1,000 words. I wrote and rewrote the story at least 100 times. In this task, my ingenuity in condensation, and in the presentation of my material, was taxed to the utmost. The time and labor, however, were well spent.

His next story won a prize and he has been writing ever since.

Railroad Caution.

The station master on the Eastern Indian Railway had been given strict orders not to do anything out of the ordinary without authority from the superintendent. This accounts for his sending the following telegram:

"Superintendent's Office, Calcutta:

"Tiger on platform eating conductor. Please wire instructions."

No man takes a vacation who takes his work with him.

Items of Personal Interest

Mr. Ralph Ramsey has been appointed traveling engineer of the Texas & Pacific, with office at Marshall, Tex.

Mr. T. H. Nanney has been appointed general foreman of the Buffalo & Susquehanna, with office at Galeton, Pa.

Mr. Frederick S. Brown has been appointed mechanical engineer of the Erie Railroad with headquarters at Meadville, Pa.

Mr. N. J. O'Connor has been appointed master mechanic of the Florence & Cripple Creek, with office at Colorado Springs, Colo.

Mr. B. A. Eldridge has been appointed general foreman of the Santa Fe, at Arkansas City, Ark., in place of Mr. E. P. Gray.

Mr. D. F. McLowe has been appointed master mechanic of the Missouri, Kansas & Pacific, with headquarters at Shreveport, La.

Mr. H. O. English has been appointed master mechanic of the Texas City Terminal at Texas City, Tex., in place of Mr. F. A. Scott.

Mr. W. E. Maxfield has been appointed master mechanic of the Texas & Pacific, with office at Big Springs, Tex., in place of Mr. C. E. Boss.

Mr. W. L. Kellogg, superintendent of motive power of the Pere Marquette, has changed his headquarters from Detroit to Grand Rapids, Mich.

Mr. J. B. Stewart has been appointed master mechanic of the Texas, Oklahoma & Gulf, with office at Bismarck, Okla., in place of Mr. H. Reed.

Mr. G. M. Wilson has been appointed general foreman of the Grand Trunk shops at Toronto, Ont., in place of Mr. W. C. Seally, promoted.

Mr. C. C. Hayman has been appointed road foreman of engines on the Middle division of the Santa Fe, with headquarters at Newton, Kan.

Mr. S. H. Lee has been appointed foreman of locomotive repairs of the Chicago, St. Paul, Minneapolis & Omaha, with office at East St. Paul, Minn.

Mr. E. Norton, formerly road foreman of engines on Western division of Santa Fe, has been appointed division master mechanic at Dodge City, Kan.

Mr. W. A. Chamberlain has been appointed master mechanic of the Pere Marquette, with office at Saginaw, Mich., in place of Mr. F. C. Pickard, resigned.

Mr. George P. Kempf has been appointed engineer of tests of the Chicago, Milwaukee & St. Paul, at Milwaukee, in place of Mr. R. H. Morrison, resigned.

Mr. J. F. Sheahan has been appointed superintendent of motive power of the Atlanta, Birmingham & Atlantic, with office at Fitzgerald, Ga.

Mr. W. W. Hamilton, road foreman of engines of the Middle division of the Santa Fe, has been transferred to the Missouri division, with headquarters at Shopton, Iowa.

Mr. W. C. Sealey has been appointed assistant master mechanic of the Middle and Southern divisions of the Grand Trunk, with office at Toronto, Ont.

Mr. Henry Lewis has been appointed machine-shop foreman of the Santa Fe at Clovis, New Mexico, and Mr. J. D. Costello has been appointed erecting foreman at the same place.

Mr. T. W. Callahan has been appointed master mechanic of the Mesabe division of the Great Northern, and Mr. N. Osgard has been assigned to the Superior division as master mechanic. Both have offices at Superior, Wis.

Mr. R. E. Bell, formerly general foreman of the Gulf, Colorado & Santa Fe, at Galveston, Tex., has been appointed master mechanic of the Galveston division, with office at Galveston.

Mr. F. Slater, formerly master mechanic for the Chicago & North Western at Escanaba, Mich., has been transferred to Kankana, Wis., and Mr. E. Becker succeeds Mr. Slater at Escanaba.

Mr. J. E. O'Hearne, formerly master mechanic on the Wheeling & Lake Erie, has been appointed superintendent of rolling stock of the Chicago & Alton, with headquarters at Bloomington, Ill.

Mr. E. Schultz, formerly roundhouse foreman of the Chicago & Northwestern, at Milwaukee, Wis., has been appointed master mechanic of the Northern Wisconsin and Lake Shore divisions at Green Bay, Wis.

Mr. A. L. Fillmore has been appointed master mechanic of the Northern district of the Minneapolis, St. Paul & Sault Ste. Marie, with office at Stevens Point, Wis., and Mr. A. V. Birch has been appointed master mechanic of the Southern district.

Mr. G. B. Seimantel has been appointed master mechanic of the St. Louis, Rocky Mountain & Pacific Railway, with office at Cimarron, N. M. Mr. Seimantel will have charge of the mechanical and store departments of the company.

Mr. H. M. Hutton has been appointed master mechanic of the Baltimore & Ohio, at Grafton, W. Va. Mr. P. Coniff has been appointed assistant superintendent of shops at Mount Clare, Baltimore, Md., and Mr. J. W. Adams has been appointed general foreman at the same place.

Mr. H. Clewer has been appointed superintendent of locomotive operation of the Rock Island Lines, with office at Chicago, Ill. Mr. Clewer is a typical western railway man, and has had an extensive experience, chiefly in the mechanical department of a number of western railways.

Mr. E. C. Hanse, formerly general foreman of the Georgia & Florida, at Douglas, Ga., has been appointed acting master mechanic, with office at Douglas. The Chicago & Northwestern has ordered 29 six-wheeled switching locomotives from the Baldwin Locomotive Works.

Mr. A. M. McGill, formerly superintendent of the Sayre shops of the Lehigh Valley, at Sayre, Pa., has been appointed assistant superintendent of motive power, with office at South Bethlehem, Pa., and Mr. J. C. Seeger has been appointed to the position made vacant by the promotion of Mr. McGill.

We regret to learn that Mr. George Burnham, who for many years was senior member of Burnham, Perry, Williams & Co., of the Baldwin Locomotive Works, is seriously ill in his home in West Philadelphia. Mr. Burnham is ninety-six years of age, but he is such a robust, well preserved man, that his friends hope he will pass the 100 years lease of life before the end comes.

Few people are closer observers of national characteristics than J. H. Maddy, special agent of the Erie, who is a Virginian by birth and thinks he comes of Scotch stock. Mr. Maddy says that the result of his observations is that an Englishman is never happy unless he is grumpy, that a Scotchman is happy only when he is contradictory, and that an Irishman feels peaceful only when he is fighting.

Mr. George H. Emerson, who has been appointed general manager of the Great Northern, is said to be the first boiler maker to reach such a position. He worked for eight years in the boiler shops at St. Paul. He was afterwards fireman and engineer on the Dakota division of the road, and was locomotive foreman at Glasgow, Mont., in 1895, and was promoted to master mechanic. On January 1, 1900, he was appointed general master mechanic of the Western division, and in 1903 he was advanced to the position of superintendent of motive power, and on March, 1910, was appointed assistant general manager.

Mr. T. Rumney, second vice-president of the Rock Island Lines, has appointed Mr. H. Clewer superintendent of locomotive operation with headquarters in Chicago. The circular of appointment says: He will superintend the work of the supervisors of locomotive operation, through the master mechanics, to effect further economies in the use of fuel, locomotive supplies, lubricating material and in the operation of the locomotive. He will also render every assistance possible, through the various officers, to improve the maintenance, efficiency and operation of the locomotive by further instructive methods, in order that the cost of locomotive operation will be reduced and its efficiency improved.

Mr. Samuel Rea has been elected president of the Pennsylvania Railroad in place of Mr. James McCrea, who retires from active service. Mr. Rea began railroad service with the Pennsylvania in 1871, at the age of sixteen, as a chainman and roadman in the engineering department. From 1875 to 1877 he was assistant engineer in the construction of the suspension bridge over the Monongahela river at Pittsburgh, Pa., and was afterwards engaged as assistant engineer on the Pittsburgh and Lake Erie. In 1879 Mr. Rea returned to the Pennsylvania and was engaged in construction work until 1883 when he was appointed as assistant to the vice-president. In 1889 he was elected vice-president of the Maryland Central, and also served as chief engineer of the Baltimore Belt railroad. In 1892 he was chosen assistant to the president of the Pennsylvania. Shortly afterward Mr. Rea proceeded to London, England, and made an extensive report on the underground railway system there, which was utilized to much advantage in the construction of the New York tunnel extensions. Recently Mr. Rea has served in the capacity of the various vice-presidencies of the company, and for a number of years has been in charge of the engineering and accounting departments. He will assume the full duties of president on January 1, 1913.

Mr. H. F. Bickel, who has been elected president of the New York Air Brake Company, was born in Pottsdam, Pa., and served a regular apprenticeship as a machinist in the shops of the Lehigh Valley Railroad at Delano, Pa. He was afterwards appointed shop foreman at Buffalo in the same company, and after several years went to the Pennsylvania shops at Wilmington, Del., where he had charge of the air brake department. Later he was placed in charge of a contract department in the Baldwin Locomotive Works, and had charge of the construction of a large number of locomotives. He was latterly connected with the New York Air Brake Company as one of their representatives, and was promoted to engineer of tests. In 1902 he perfected important improvements in the Vaugh-McKee air brake devices, and was shortly afterwards appointed manager of the company's works at Watertown, N. Y. Mr. Bickel has invented and patented many important improvements on the air brake, and the growing demand for the New York Air Brake Company's products are owing in a large measure to Mr. Bickel's inventive faculty which has placed him in the front rank of the engineering inventors of our time. He is a gentlemanly and courteous man of affairs, and the marked success that has come to him has not detracted from his modesty or genial good fellowship. He is still in the prime of life, and much more excellent work may be expected from his expert hands and gifted mind.

Obituary.

REUBEN WELLS.

Reuben Wells, who was the only survivor among the six railway master mechanics who met at Dayton, Ohio, in June, 1868, and organized the American Railway Master Mechanics' Association, of which he was for three years president, died at his home in Paterson, N. J., on November 8, aged 83 years. The following account of the career of Reuben Wells is copied from "Development of the Locomotive Engine," by Angus Sinclair:

"Among the railroad mechanics who began work about the middle of the 19th century and continued putting their personality upon locomotives of the 20th century, Reuben Wells, for the last twenty years superintendent of the Rogers Locomotive Works, has been very prominent.

"The railroad engineering career of Mr. Wells began in 1849 when he entered the shops of the Philadelphia and Reading Railroad as an apprentice. He served first under Lewis Kirk and afterwards under James Millholland, taking part as a workman in the development of the locomotive worked out by these two pioneer improvers.

"In 1852 Mr. Wells went to Shelbyville, Ind., and was appointed master machanic of three small railroads that were afterwards absorbed by the Jeffersonville and Indianapolis Railroad. He followed the fortunes of that company for twenty-five years, until he left in 1878 to fill the position of superintendent of machinery of the Louisville & Nashville Railroad.

"During the Civil War the railroads in Southern Indiana were loaded with burdens and responsibilities unknown to ordinary experience. In the summer of 1863 the fortunes of war made it necessary for the railroad on which Mr. Wells was master mechanic to transport the 11th and 12th army corps from the Army of the Potomac to Nashville, Tenn., in the shortest possible time and with the least public notice. An officer from the War Department came to take possession of the railroads, and the work was done with extraordinary expedition, but Mr. Wells directed the whole of the train movement, having acted as superintendent, master mechanic, yardmaster and train dispatcher for eight days.

"As already mentioned, Mr. Wells became superintendent of machinery of the Louisville and Nashville Railroad in 1878. About that time six other railroads were added to the Louisville and Nashville system, extending it from Cincinnati to New Orleans. The newcomers were roads that had struggled along with worn out machinery. When an inventory of locomotives and cars was taken it was found to constitute the most extraordinary variety of patterns ever put under one ownership.

"In 1887 Mr. Wells left the Louisville & Nashville to become superintendent of the Rogers Locomotive Works at Paterson, N. J., a position he held for twenty years, with much credit to himself and to the company."

VAUGHAN PENDRED.

Mr. Vaughan Pendred, for many years editor of *The Engineer,* a popular British publication, died last month in his seventy-sixth year. He was a native of County Wicklow, Ireland, but lived the greater part of his life in London. He succeeded Mr. Zerah Colburn in the editorship of *The Engineer* in 1865, and held the position over forty years. He was a member of the leading engineering societies in Great Britain, and was one of the leading engineering writers of the last century. His style was marked by lucidity of expression, and while he found in locomotives a lifelong source of interest, marine work also shared his attention in a lesser degree.

CLINTON B. CONGER.

Clinton B. Conger, the well known writer on railway topics, died on October 29, at the age of 65 years. Mr Conger was one of the first engineers on the Chicago & Grand Rapids Railroad, now part of the Grand Trunk railway system. He was the first man advanced to the position of traveling engineer of that line, and left that to become consulting engineer for the Railroad Commission of Michigan. In 1899 he became one of the editors of Locomotive Engineering, and remained with the paper for several years, and then went into the service of the International Correspondence Schools of Scranton, Pa. In 1908, Mr. Conger entered the employ of William Sellers & Co., Philadelphia, as traveling representative, a position he held at the time of his death. He took a leading part in organizing the Traveling Engineers' Association, and was president of that organization for five terms. He was treasurer of the association to the end of his career. Mr. Conger is author of "Air Brake Catechism," one of the most popular treatises on the subject that has ever been published.

JOSEPH DAVENPORT.

Mr. Joseph Davenport, a well known railway man, died last month, in the ninety-seventh year of his age, at Zoar, O. It is claimed that he built the first locomotive pilot, the first engine cab, the first wrought iron cantilever bridge, and a few years ago began work on a novel design of an airship, which he hoped to sail before his death.

Arbitrators Award on Engineers Demand.

As we go to press a telegraphic summary of the award of the Board of Arbitration between the railroads and the engineers has reached us. The award is a sort of compromise for while it does not grant much of the engineers demands, it establishes minimum rates which amount to a substantial increase on some of the roads.

Warren S. Stone, Grand Chief of the Brotherhood of Locomotive Engineers said: "I have no comment to make on the fairness or unfairness of the decision. It speaks for itself. On April 29 last we signed articles of arbitration and agreed absolutely to stand by whatever decision was rendered by the board. Personally, I am satisfied."

Mr. Daniel Willard, representing the employers side says:

"My acceptance of the award as a whole does not signify my approval of all the findings in detail. It is intended, however, to indicate clearly that although the award is not such as the railroads had hoped for, nor is it such as they felt would be justified by a full consideration of all the facts, yet, having decided to submit their case to arbitration, and having been given ample opportunity to present the facts and arguments in support of their position, they now accept without question the conclusion which was reached by the board appointed to pass upon the matters at issue."

An Important Committee.

At the request of the Interstate Commerce Commission and the American Railway Association a committee has been appointed to enforce the rules governing interchange of cars, with power to impose penalties on delinquent railroads. The committee which is quite influential consists of President Harrison, of the Monon; R. H. Ashton, vice-president of the Chicago & Northwestern; T. E. Clarke, assistant to president of Lackawanna. It is expected that this action will do much to prevent shortage of cars.

An Eminent Scot.

In giving a short list of men whom he considered Scotland's greatest natives, Andrew Carnegie mentioned the name of William Murdock and we notice that several of our papers have been repeating the question, who in the world was William Murdock? We are ashamed to notice this widespread ignorance about the man whose work helped materially to the success of Boulton and Watt, who made a working model of a locomotive as early as 1784, a line of invention he would have pursued but for the active opposition of Watt. He was the inventor of gas lighting.

William Murdock was born in Ayrshire, Scotland, in 1754, five years earlier than Robert Burns, who has made Murdock's birth place, Old Cumnock, famous. It is not recorded that these the two greatest sons of Ayrshire ever met. Murdock's father was a millwright and the son was trained to that business. He became a wonderfully skilful mechanical engineer and demonstrated the erroneous theory of Watt that Scotchmen had not the qualities that make good mechanics.

The World's Greatest Engineering Achievement

The Panama Canal which will permit ships to pass through next year, is easily the greatest work ever planned by human brains and carried out by human labor. The building of the pyramids of Egypt have always been regarded as magnificent achievements; the building of ancient Rome with its temples, baths and aqueducts have been considered stupendous; but the excavation of the Panama Canal and the engineering achievements involved pale into insignificance all other works ever executed.

Making the Panama Canal presented engineering problems without precedent in their magnitude and variety. First came the problems of sanitation, which converted the most deadly of climates into a healthy region. Then came the control of the Chagres river, a torrential stream whose floods had defied control; the piercing of the Culebra cut with its fantastic geological formation, and the devising of electrical machinery to operate the locks that would stand the climate, as well as the locks themselves, which are the largest ever built.

Culebra hill, which had to be pierced, by its eccentric and geologically "faulty" formation has added over one-third to the average cost of excavation of canals through earth and rock. There have been "slides" of the Culebra banks where the grade was as low as one foot in seven. One such "slide" is now being removed which covers 63 acres. The encouraging feature of the situation is that none of the "slides" of the last year would have blocked the canal. Even after the canal is "finished" there will probably be digging out of "slides" to be done, but ships will pass just the same.

The floods of the Chagres have been impounded by creating a great inland lake, about 85 feet above the sea level. This furnishes an enormous water power used to generate electric power for opening and closing the lock gates. To apply this electric power dynamos and motors had to be devised that would work for 10 days in a building filled with steam and for hours with the cases filled with water, without "short-circuiting." And it has been done. The severest tests ever given electrical machinery have been met by American skill in construction. The great gates, as tall as the ordinary "skyscraper" and as heavy, are opened or closed in the average time of one minute and 48 seconds.

That is the sort of work American engineering genius and mechanical skill has given the American people for the $350,000,000 they have spent or will spend on the national achievement and international benefit of linking the oceans at Panama.

Frau Krupp Hotel.

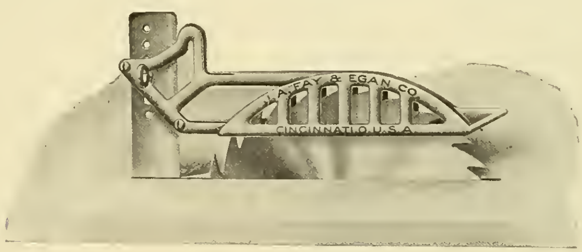
In the little town of Essen, Germany, is a hotel—a first-class hotel—at which the principal guests who put up there never have to pay for their accommodation. It is owned by Frau Bertha Krupp, the richest woman in Germany, and owner of the great Krupp works at Essen. She runs it at a loss of more than $100,000 a year. This hotel was built by Frau Krupp solely for the entertainment of the representatives of foreign governments who visit Essen to superintend the execution of orders. Ordinary travellers sometimes can find accommodation at the Krupp Hotel, but only when the rooms are not required for Frau Krupp's foreign official guests. Railway mechanical officials are always welcome and never fail to find room, especially Americans introduced by any of the Prosser Brothers.

An Aluminum Saw Guard.

Herewith is shown a photograph of a new idea from the J. A. Fay & Eagan Co. It is a saw guard made of aluminum. That this guard is the most efficient safety device made for circular saws is evident by the large number already in use. It is very light and does not interfere with the operation of the saw, nor mar the work in any way. Neither will it damage the blade should the hood by some accident be forced against it. The protection afforded is perfect, the guard complying with all safety appliance laws in every respect. The guard is mounted on a steel standard set into a plate which is countersunk into the table. The standard is easily removable, while the hood is quickly set for various thickness of stock or can be thrown when not desired.

This guard affords protection not only to the operator but to the manufacturers as well. The laws of practically every state now make it obligatory to use saw guards and where none are provided there is no defense against an action for damages for injuries sustained by the operator. Now that there is made a really practical guard, one which affords the needed protection without decreasing the efficiency of the operator, there is no excuse for not applying them to every circular saw. It is a case where a few dollars invested now is an insurance against a loss of thousands of dollars later on.

Further information in reference to these guards may be had upon application to J. A. Fay & Eagan Co., 445 W. Front street., Cincinnati, O.



ALUMINUM SAW GUARD.

Water Cost Was $3 Per Pail.

Engineers frequently meet with surprises in the expenses of work for operations pushed into a new territory. A firm of British engineering contractors obtained a contract to construct a railway in Bolivia, and they had not proceeded far with the mountain route when it was found that water cost three dollars for each pail procured. That water supply was carried a long distance from the Andes on mules. To escape absolute ruin the contractors laid down a pipe line measuring 75 miles, at a cost of $3,000,000, or $40,000 per mile.

Speed Paradox.

One of the most remarkable things about motorboats is the fact that while most any craft with a bottom and an engine in it can do a mile a minute in practice and during "tuning up" spins, none of them seem to be able to surpass 40 miles an hour in a regular regatta, over a measured course, with stopwatches held on them by competent timers.

So far this season different craft have traveled at the rate of 49, 54, 60 and 67 miles per hour in tryouts and maiden trips. In active competition, however, they all consistently fell back to the customary speeds of 30-40 miles. That is, all of them did, with the exception of those which sank during races.

Steel Mills Boom.

In connection with the agitation in favor of tariff reduction we have heard expressions of sympathy for the poor American steel makers likely to be struck by reduction of import duties. Latest news seems to imply that the sympathy is misplaced for it is announced in New York that the steel corporation has received an order for 50,000 tons of steel rails, the quantity allotted to be made in this country, from the Australian government, the rails to be used on the Commonwealth railroad. This order was procured in competition with all the leading rail manufacturing plants in the world, according to the report, and the order is regarded as another victory for American enterprise and skill.

The reports of the steel plants show that there is to be manufactured for delivery next year an enormous number of steel rails for the railroads in this country, with orders for lines abroad, the total of the orders now on the books of the steel companies aggregating more than 2,500,000 tons of rails. This means that the rail mills will not only be continuously busy during the winter, but, most likely that they will add thousands of men to their working forces, if they can get them. This season the mills have had great difficulty getting workmen, particularly the laboring classes, who are drifting into other occupations.

RAILROAD NOTES.

The Wheeling & Lake Erie has ordered 5,000 tons of steel rails for 1913 delivery.

The Terminal Ry. of St. Louis, Mo., it is stated, has ordered 4,200 tons of steel rails.

The Missouri, Kansas & Texas is reported to have ordered 16,000 tons of steel rails.

The Southern Electric of Texas is reported to have contracted for 12,000 tons of steel rails.

The Missouri, Kansas & Texas will erect a new station at Temple, Tex., to cost about $600,000.

The Long Island has ordered six freight locomotives from the American Locomotive Company.

The Pittsburgh & Lake Erie has ordered 1,500 coal cars from the Pressed Steel Car Company.

The Boston & Maine has ordered 50 consolidated locomotives from the Baldwin Locomotive Works.

The Pittsburgh & Lake Erie has ordered 12,000 tons of steel rails from the Carnegie Steel Company.

The Commonwealth, of Australia, is reported to have issued an inquiry for 167,000 tons of steel rails.

The Puget Sound & Baker River has ordered one ten-wheel locomotive from the Baldwin Locomotive Works.

The New York, New Haven & Hartford, it is reported, is in the market for about 40,000 tons of steel rails.

The Duluth, South Shore & Atlantic has ordered 400 ore cars from the American Car & Foundry Company.

The Chicago, Terre Haute & Southeastern has ordered 900 coal cars from the Haskell & Baker Car Company.

The New York, New Haven & Hartford has ordered 100 all-steel passenger coaches from the Standard Steel Company.

The Chicago, Burlington & Quincy has ordered five six-wheeled switching locomotives from the Baldwin Locomotive Works.

The Chicago & North Western has ordered twenty-nine six-wheel switching locomotives from the Baldwin Locomotive Works.

The Norfolk & Western is reported to have ordered 14,000 tons of steel rails from the Tennessee Coal, Iron & Railroad Company.

The New York, Ontario & Western is in the market for 500 hopper cars, 400 flat cars, 300 box cars, 50 stock cars, and 50 refrigerator cars.

The Chicago, St. Paul, Minneapolis & Omaha has ordered five six-wheeled switching locomotives from the Baldwin Locomotive Works.

The Paulista Railway, Brazil, has ordered four ten-wheel locomotives and one Mallet locomotive from the American Locomotive Company.

The Erie has ordered thirty Mikado locomotives from the Baldwin Locomotive Works, and five Pacific type from the Lima Locomotive Works.

The Baltimore & Ohio has ordered 410 tons of structural steel to be used for street crossings in Baltimore, Md., from the American Bridge Company.

The Interborough Rapid Transit Company, New York, is reported to have ordered 7,000 tons of steel rails from the United States Steel Corporation.

The Chicago, Rock Island & Pacific is said to be in the market for thirty Pacific type locomotives, twenty-five Mikado locomotives and thirty switching locomotives.

The New York, Philadelphia & Norfolk has ordered 800 box cars from the American Car & Foundry Company, and 50 gondola cars from the Ralston Steel Car Company.

The Great Northern has awarded the American Bridge Company contracts for 4,784 tons of bridge material to be used in bridges over the Missouri River and Yellowstone River.

A contract has been awarded to the Foster-Creighton-Gould Company for 5,500 tons of steel for the metal work on the new bridges on the line between Winchester, Ky., and Athol.

The Long Island has ordered four superheated ten-wheel freight locomotives having 21 x 26-in. cylinders, driving wheels 60½ ins. in diameter and a total weight of 178,000 lbs. in working order, from the American Locomotive Co.

Books, Bulletins and Catalogues

Proceedings of the Air Brake Association.

The proceedings of the nineteenth annual convention of the Air Brake Association, which was held at Richmond, Va., May 7-10, last, have just been published in a handsome volume of 374 pages, and bound in flexible leather. The convention was more than usually interesting and the subjects discussed were among the most important in the department of the air brake. The opportunities for complete tests of appliances and materials are becoming more available year by year, and the members of the Air Brake Association are keenly alive to the growing advantages. The volume is probably the best of its kind yet published. The papers presented and the discussions appear in full. The illustrations are excellent and the press work of the best. Copies may be had on application to the Secretary of the Association, 53 State street, Boston, Mass.

Automatic Hose Coupler.

The D and D automatic Hose Coupler Company, of Leavenworth, Kan., have placed on the market a new and improved hose coupler which has the double merit of fitting any size of hose and has also the quality of coupling instantly without the use of any tools. Such a coupling, suitable for steam, water or compressed air, is a growing necessity and the new device admirably meets the situation. In railroad and fire department and in general engineering work, the new coupling bids fair to come rapidly into favor. Descriptive circulars may be had on application to the company's office, Leavenworth, Kan.

Wood Locomotive Fire Box.

A very interesting report has just been published in regard to the Wood Corrugated fire box and tube plates in service on several locomotives on the New York Central & Hudson River Railroad. Three of these locomotives have been running over four years, and it was found that not one stay was broken between the corrugations in the fire box sheets, the few that were broken being on the back head of the boiler where there were no corrugations. No other conclusion can be arrived at than the corrugations on the fire box sheets admit of expansion and contraction without any undue strain on stays or other parts. It may be added that the boilers had had their fourth set of flues during the period referred to, but no repairs of any kind had been made on any part of the fire box. Details of tests and full particulars may be had from the Wm. H. Wood Loco. Fire Box and Tube Plate Co., Media, Delaware Co., Pa.

Diamond Steel Emery.

The Pittsburgh Crushed Steel Company have issued a descriptive booklet setting forth the qualities of Diamond Steel Emery. The abrasive qualities of the substance are already well known and it is in demand on a large number of the leading railroad shops and other works. It is claimed that it outwears the best artificial or natural abrasive ten to one. It does not pulverize. Its cutting qualities are unequalled. Ask for a sample from the company's works, Pittsburgh, Pa.

Car Seat Evolution.

The Scarritt Car Seats are in use on nearly all of the principal railroads in America and also in many other countries. Those who desire to be informed of the latest variations in designs and elegancies in finish and decoration in car seats should send for a copy of "Car Seat Evolution," a handsomely illustrated booklet on the subject just issued by the Scarritt-Comstock Furniture Company, St. Louis, Mo.

Keystone Lubricating Company Tests.

Some important tests have been made on the Wabash railroad with the Keystone Lubricating Journal Boxes and authoritative data has been compiled for a period of nearly a year, and it is claimed that the official test shows a combined saving of over 93 per cent. of the cost attending the operation of the old style standard form of boxes in use. Details may be obtained from the company's office, Philadelphia, Pa.

Electric Headlight.

We have received from Mr. John F. McNamee, Editor of the *Fireman's Magazine*, Indianapolis, Ind., a copy of a very valuable little book called Catechism of the Electric Headlight, which has been in print for several years but is nevertheless well worthy of being brought to the notice of our locomotive readers. The questions and answers were prepared by Mr. J. Will Johnson, of the Pyle National Headlight Co., who is an expert on this form of headlight. Firemen who are facing an examination for promotion cannot do better than send 50 cents to purchase this help over the examination grade.

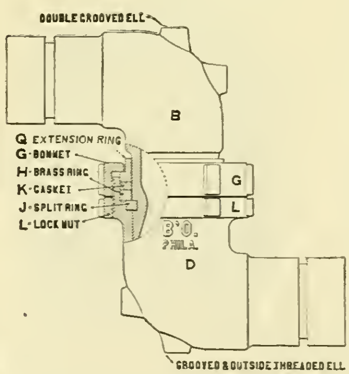
We love the man with the torch and wrench,
Who nightly ambles 'twixt pit and bench;
Under the ash pan, crawling he thinks,
Bumping his head 'gainst axle and links;
Cussing awhile, then thinking it o'er,
He draws the water from the reservoir.

The Bordo Swing-Joint.

The Bordo Swing-Joint is self explanatory. There are no fittings liable to unscrew and become disconnected, as shown by the Double Grooved Ell and the sure, the wearing parts are all protected from the fluid passing through the joint. This prevents cutting the seat, a very essential feature. All adjustments can be made with a spanner wrench.

COMPLETE CONNECTION BETWEEN ENGINE AND TENDER FOR AIR BRAKE, AIR SIGNAL, STEAM HEAT AND WATER SUPPLY.

Grooved and Outside Threaded Ell. The bonnet is slipped over the Double Grooved Ell, followed by two brass rings and a gasket placed between them, which in



DETAILS OF BORDO SWING JOINT.

turn are held in place by a brass split ring, set into grooves in the Double Grooved Ell, and then placed in the Outside Threaded Ell. These parts are adjusted to their proper seat by screwing down the bonnet; the latter being held firmly in place by the lock-nut.

A special feature of the joint: No matter which end of the joint admits the pres-

A Rolling Redoubt.

The Mexican Government has lately found one of its most useful implements of warfare to be a peculiarly devised car completely sheathed in sheet steel. In other respects it is built much on the lines of an ordinary box car.

The outside of the car is painted in black and white squares, checkerboard fashion. Although these would seem at the first consideration to give the rolling fortress an unpleasantly conspicuous and targetlike appearance, they have their purpose. Certain ones of the squares are loopholes, but at a distance of so little as fifty yards the black of the loopholes is found to be indistinguishable from that of the other black squares. The car has about a hundred loopholes, yet practically all of these are invisible. The enemy is left with nothing to shoot at unless he is satisfied to pump away his ammunition against steel sheathing.

The interior of the car is somewhat dark and stuffy, although an air space is provided between outer and inner walls to reduce the discomfort from the sun's heat pelting down on the metal exterior. The door admits entry through a narrow passage, walled also with steel. The car carries an armament of three quick-firing guns at each end and fifty or more rifles.

Were Fast Trains.

An Englishman, an Irishman and a Scotchman were one day arguing as to which of the three countries possessed the fastest trains. "Well," said the Englishman, "I've been in one of our trains running at a high speed and the telegraph poles seemed like a hedge."

"I've seen the mile stones appear like tombstones," said the Scotchman.

"Be jabbers," said Pat, "I was one day on a train in my country, and as we passed in succession a field of turnips, a field of carrots, a field of cabbage and then a large pond of water, we were going that quick I thought it was broth."

Why Station Agents Go Crazy.

"Do you suppose No. 17 will be in on time day after tomorrow? Why not?"

"Can you tell me if a young lady in a blue dress and straw hat got off the train which got in from the north at 2:10?"

"Is the train going to get into Fort Wayne on time, do you think?"

"What made No. 7 so late a week ago last Tuesday?"

"Do you think it is safe to ride in a parlor car, or is there apt to be a rear end collision?"

"Have you noticed an old gentleman with white whiskers and a telescope go through the gate any time today?"

"I lost a back comb on the south-bound train three weeks ago last Wednesday. Can you tell me where I can find it?"

Made Her Bile Over.

Our friend A. R. McAlpine tells this story on Reuben Wells. During the great strike, 1877, Mr. Wells was master mechanic of the J. M. & I. Ry., and as it was impossible to find an engineer to take out the locomotive of the principal express train from Louisville to Indianapolis, he made up his mind to act as engineer. He started out all right, a lanky farmhand acting as fireman. Reuben was a little nervous himself, not having run an engine for twenty years, and he kept the pump going so steadily, that the boiler had more water than it could digest and began priming. The fireman watched the water pouring through the stack and siding over to Mr. Wells, tapped him on the shoulder and exclaimed boastfully: "I'm the boy to make her bile over."

Losing Things.

Guard, to the most cheerful bandsman of a cheerful party, returned from a country show: "Where's your ticket?"

"Loshtit."

"Nonsense, man. Look again; you can't have lost it."

Bandsman (beaming)—"Couldn't I? I—I've losht th' big drum."

Good Character.

A good many young fellows when they begin working in a shop or an office are anxious to make believe that they are fast young men who have seen much of shady life. They do not reflect that they are trying to lower their own characters, the most precious heritage a young man can possess.

A man's reputation is a large part of his capital. The business man must have a good name or his business will not prosper. A good name is an essential thing for a young man who goes out to find a business opening. If his good name is gone who will employ him? When one's reputation is tarnished his influence is gone. When the good name of an innocent person is soiled by the tongue of slander most people will say it is a natural occurrence which could not be avoided; and some will say it is a strange providential visitation. It is not always so. Sometimes it is a clear case of giving that which is holy to the dogs. If young people were prudent and careful to avoid the appearance of evil they might, as a rule, escape the shame and humiliation of a bad name. But they are not always prudent. They are often found in places where they ought not to be. They often go into company which awakens suspicion. If they are warned of danger they scoff at the warning and defy public sentiment. They are not afraid. They may be innocent but they are not prudent. A good name which has been handed down through many generations without a spot is worth guarding with scrupulous care.

Car Shortage Not Bad.

A supplemental report sent out by the American Railway Association shows that the shortage of cars throughout the country is not nearly so severe as was forecasted in the beginning of November. This improved condition is said to be owing to the urgency of the railroads in compelling shippers and consignees to lead or unload cars promptly, as well as to the co-operation by the patrons of railroads to handle cars with all possible dispatch.

The car shortage reported in the middle of November was slightly more than 71,000, as compared with 300,000 which was predicted two months ago for the first part of November. The severest shortage, naturally, is in grain cars, and coal cars have been scarce on some lines running from the mines, particularly from the soft coal fields. The supply of soft coal is good at this end of the lakes but at the upper end the shortage is beginning to be felt and there is danger of soft coal famine before Christmas.

Happiness lies in the consciousness we have of it, and by no means in the way the future keeps its promises.

Railway Pay in America and in Europe.

According to the Pittsburg *Post* figures compiled and published recently discloses the fact that upwards of 1,755,000 persons are in the employ of American railroads at the present time. Assuming each represents a family of four or five, approximately 5,000,000 people are dependent for food, clothes and shelter upon the railway pay envelope. And since $42 of every $100 a railroad earns goes to labor, it is easy to figure that the annual payroll of American railroads amounts to the tidy sum of $1,172,181,000.

In addition to the immediate family of the railroad employee there is, also quite an army of other persons who have interest in the disposition of railroad employees' wages. But how about his pay? If he is a clerk of the general office class he averages a wage of $2.38 per day; if he is a station agent he will average $2.13; if he is a fireman he will draw around $2.74; if he is an engineer he gets $4.59 per day, and if a conductor his average is $3.93. If he is merely a trackman, of whom there are over 375,000 (mostly foreign born) employed on the American railroads, his average wage per day is $1.47.

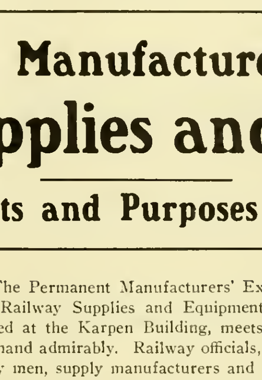
With more than double the number of employees the railways of Europe and Siberia pay $135,000,000 less to their employees than do the railways of the United States, and many of the European railways are under the government ownership principle, whereas the railways of the United States are entirely owned either by individuals or corporations.

Permanent Manufacturers' Exhibit
Railway Supplies and Equipment
Notes of the Exhibits and Purposes of the Management

As we have frequently stated in the pages of RAILWAY AND LOCOMOTIVE ENGINEERING, the city of Chicago, by reason of its central location and rapidly expanding facilities for interstate traffic, has gradually become the railway center of America. It was only natural and proper to expect that these advantages would be observed by enterprising railway men, and that means would be devised not only to facilitate the great and growing traffic incidental to such a position, but that opportunities would also be furnished for the ready interchange of opinion in regard to the best methods and appliances that might still further the important work in which railway men are engaged.

As is well known, the leading manufacturers of railway supplies are scattered far and wide, some necessarily in the coal and iron regions, others in the vicinity of products essential to the particular work in which they are occupied, and others in industrial centers, where the work of assembling is facilitated by contiguity to other manufacturing establishments. To intending purchasers it has been a matter involving time and expenditure of money to visit factories and workshops so far removed from each other, and yet it was a necessity in order that the products might be examined by experts qualified to pronounce on the merits of the required appliances; and while annual exhibitions have, to some extent, met this growing necessity, it was a happy thought that suggested itself to some enterprising men to form a Permanent Exhibition in Chicago, where the various products could be seen together in proximity and so avoid the incidental loss of time and means in the necessary comparisons and estimates of the finished products.

The Permanent Manufacturers' Exhibit of Railway Supplies and Equipment, located at the Karpen Building, meets this demand admirably. Railway officials, railway men, supply manufacturers and dealers are already learning to economize time and opportunity by visiting the exhibit. It is our purpose to aid in this good work, and in presenting this month a brief résumé of the more important



KARPEN BUILDING, CHICAGO.

exhibits displayed for the observation and examination of all interested, we would state that this is but an earnest of what we hope to do in the future. It is our purpose to present a brief description of all new devices exhibited from month to month, and those interested in the information which we present and who desire further details may either write directly to the manufacturers or they may direct their inquiries to the officers of the Permanent Exhibit.

It may be added that the officials of the railways, including the management and purchasing agents, are enthusiastic in their approval of this economic proposition, and other railway men along the line are constantly expressing their satisfaction at the facilities now afforded them for inspecting, without trouble, particulars in which they are interested and invariably find new and interesting subjects that will repay them for the time spent in visiting the exhibition.

Among the exhibits that are being added to almost daily, the following are especially worthy of notice:

The Kinkaid brake shoe is unique in that it lubricates the flanges of the wheels. The Barco flexible ball joints are shown on dummy connections. The Joliet Railway Supply Company exhibit various devices of importance, including the Huntoon brake beam, etc., and the Perry-Huntoon trucks; also the Perry self-centering anti-friction roller side bearings.

Self oil steel trucks are shown by the St. Louis Truck and Manufacturing Company. Concrete things are claimed for these trucks, backed by a liberal guarantee.

The O. M. Edwards Company have an exhibit favorably compared with any of those made at the prominent conventions. It is needless to say that the Crane Company are making a creditable display of their well-known line.

A new car-sealing device, which must be seen to be appreciated, is shown by the Wire-Wood Seal Company, and a sample will be promptly mailed upon request. The United States Metallic Packing Company show their standard "King" type metallic packing, together with proof of its worth and universal use. Water softening

machinery is discoursed upon by the representative of the Kennicott Company.

The celebrated Kapak and paints for steel, etc., as well as Snelling boiler compounds, are brought prominently to notice by the Frost Paint and Manufacturing Company. The old and well-known firm of Heath and Milligan Manufacturing Company are represented. The Forest City Paint and Varnish Company also show an interest by their presence with their well-known goods.

It is needless to say that the Dearborn Drug and Chemical Works are well represented, and then we notice "The Car Door that Won't Come Off," and above it the sign of the Chicago Car Door Company. They claim this door is storm, spark and thief proof. One very important factor in this connection would seem to be that this door is also fool-proof.

Car heating in its most modern and economical form is shown by the Chicago Car Heating and Lighting Company, and the Curtain Supply Company show a fine line of their goods. The Gold Car Heating and Lighting Company are present with their well-known line. The Ogle Construction Company have a working model of a coaling station.

Various trade papers are in evidence, including RAILWAY AND LOCOMOTIVE ENGINEERING, *Railway Review*, *Railway Age Gazette* and the *Railroad Herald*.

Nickel chrome steel, as produced in car wheels, is of interest at the exhibit of the Nickel-Chrome Chilled Car Wheel Company, and Kneedler, Couch & Hansen show reinforced concrete ties and consistently enough is the International Interlocking Rail Joint Manufacturing Company. Further on, again, as if by preconceived arrangement, is the Coffman Permanent Way. The L.-J. Development Company show a model of their automatic connector for air, steam and electrical connections, and this device must be seen to be appreciated.

The drinking cup vending machines and similar hygienic devices are shown by the Public Cup Vendor Company. The Fire Clay Development Company has an interesting exhibit, including locomotive arches and oil burner fire-bricks. The Detroit Hoist and Machine Company demonstrate their superiority of their pneumatic and electric tractors, hoists and chain blocks. The Canton Culvert Company exhibit samples of Nestable culverts, which are *multum in parvo*. The Sterling Varnish Company has an interesting exhibit of their Sterling metal preservers. The Modoc Company show their Standard Car Cleaner, which preparation is in general use as a standard on many of the roads. The Fleming-Hebard Company represent the last four above-mentioned concerns.

The Economy Rail Creeper is an interesting device at this present time and one bound to command attention.

S. Karpen & Bros., the manufacturers of artistic furniture, which makes for quality, design and durability, are in evidence everywhere, and substantial looking devices not only comform, but give a tone and air of luxury which no other one element could supply.

MacRae's Railway and Supply Men's Mutual Catalogue is, as its name implies, an exhaustive work. The Verona Tool Works show track tools, nut locks, etc., and their goods are too well known to require much comment. Feed water weighers are presented by the Wilcox Engineering Company, and the Anderson Manufacturing Company has an oxy-acetylene outfit.

Visiting surveyors and their engineers are interested in the exhibit of the Chicago Steel Tape Company. The American Rug and Carpet Company, Railway Department, lends its finishing touches to the already attractive furnishings by suitable floor coverings of luxurious rugs, which harmonize with the general surroundings.

The United States Wind Engine and Pump Company display water columns and similar devices in interesting form. The Bogardus Company show their "Trefoil" gauges and "Trident-Hylo" water alarms. The Railway Utility Company show a varied line of Thermostatic car heating controllers, car ventilators, etc., and the Pyle-National Electric Headlight Company have a full-sized light in operation.

Having thus briefly referred to the principal products on exhibition, it may be authoritatively stated that arrangements are being made with a large number of leading manufacturing firms, who are negotiating for space in the building, that the number and variety of exhibitors will be greatly increased before the advent of the new year, and before long it is confidently expected that the exhibition will embrace all of the leading firms whose names are known in the American railway supply business. Those who have had the pleasure of visiting the exhibition are loud in their praises of the artistic setting and grouping of the products, and it is gratifying to observe the uniformity of design, as well as the general utility of the scheme of presentation.

This is not all. The management of the Permanent Exhibit have had in their mind's eye not only a central institution, where all that is best in the way of railroad appliances may be conveniently gathered together, but also an intellectual center, where conventions of the various organized bodies and meetings of railway societies could be held. To this end there are convention halls sufficiently large to hold the annual meetings of the more important and diverse associations; also smaller halls for the regular meetings of railway associations whose membership might not be so extensive.

Already numerous associations have availed themselves of the privileges extended by this proposition, and hold their regular meetings in a place provided. The exhibit hall is convenient and the attendant at any of these meetings always finds something of interest presented to his notice by sample or otherwise, and while he is studying the merits of particular devices in the line most particularly vital to his calling his associate is looking at other devices which may be to his interest, and the two talk them over afterwards.

Many advantages accrue to the exhibitors in a permanent location which would not be possible in a temporary exposition. Each exhibit is enclosed by a bronzed metal railing, the aisles between the exhibits being permanent and uniform. Each representative has his attractive office equipment, which, as well as the entire hall, is properly dusted and cared for by the management. An inter-communicating telephone system connects with every department and exhibit space, as well as long distance trunk lines at the switchboard.

A public stenographer is in attendance for the convenience of those who do not choose to employ additional office help. The management provides a competent telephone switch-board operator, messenger call services, mailing facilities, and an usher is in attendance to welcome visitors and direct them to any particular exhibit or person or to show them generally over the exposition.

Convenient to the exhibit hall and on the next floor is the Railroad Supply and Equipment Club, which is second to none in its appointments.

The entire space is well lighted and ventilated and numerous electric lights provide for evening display whenever desired. The manufacturers and supply people in railway affairs, who realize the importance of Chicago representation, are now utilizing space in this exhibit in lieu of a Chicago office. Concerns who are located in Chicago, realizing the importance of being in touch with railway men, are exhibiting their wares, although they may have elaborate displays elsewhere in the city.

Representatives of foreign governments occasionally make their appearance, and from the expression of surprise and pleasure it is quite evident that the fame of the Permanent Exhibit of Railway Supplies and Equipment is soon destined to become world-wide.

There is no admission fee charged, and the open hospitality extended to the visitors creates an impression not soon forgotten. The Karpen Building, in which this proposition is located, is a beautiful fireproof structure, on the corner of Michigan Avenue and Eldredge Place, overlooking the lake. The halls are artistically tiled and beautifully wainscoted with polished marble. The elevators are large and roomy, being equipped with all modern

safety appliances. The attendants, in their attractive uniforms, are universally courteous, and there are numerous floors of offices which can be rented by those wishing additional office space in the building.

Convenient to the convention hall is a well-conducted barber shop, cigar stand and other conveniences for the benefit of visitors, and there is also, on the ground floor, a restaurant, where lunches can be obtained at a moment's notice.

Since the opening of the exhibition, it may be stated that already a large number of railway associations and societies have availed themselves of the advantages to be gained by holding their meetings in the building. Among them may be mentioned the Car Foremen's Association of Chicago, which meets on the second Monday of each month; the Car Clerks' Association of Chicago, which meets on the first Monday of each month; the Atchison, Topeka & Santa Fe Good Service Association, which also meets monthly. During last month the Maintenance of Way and Master Painters' Association of the United States and Canada held their annual meeting in the assembly hall on November 19, 20 and 21.

Among the railway societies, the Western Railway Club, the Joint Inter-Change Association and others also availed themselves of the facilities of the building for holding their regular meetings, and a very interesting feature has just been added by opening a course of lectures, which are held on Saturday evening of each week and which have been largely attended. The object of these lectures is to give the exhibitors an opportunity to describe fully and demonstrate clearly the various devices that they have on exhibition. Already some of the leading experts in the various departments of railway appliance construction have appeared, and it is the intention of the management not only to give all an opportunity to explain the advantages of the products upon which they speak and demonstrate, but to invite the leading men in the various departments of railroad construction work to deliver discourses on special subjects, and in this way to facilitate the solution of the many problems that are constantly arising in the field of railroad operation and creating discussion among railway men.

It will be our duty, as well as a pleasure, to take notice of these meetings and present, from time to time, the more salient features of the vast flood of information that may justly be expected to arise from such excellent opportunities of interchange of opinion among men who are so qualified by education and experience to aid in the good work in which we have been engaged, and we have already the best assurances that our co-operation in the work will be abundantly appreciated.

DIRECTORY OF THE

Permanent Manufacturers' Exhibit Railway Supplies and Equipment

Twelfth Floor, Karpen Building — 900 So. Michigan Boulevard, CHICAGO, ILL.

Booth No. 49.

AMERICAN RUG AND CARPET COMPANY.

A complete line of specially designed rugs and carpets for railroad use.

Booth No. 47.

ANDERSON MANUFACTURING CO., THE.

OXY-ACETYLENE WELDING AND RECASTING PLANTS, for reclaiming broken parts of machinery, as well as general repairs.

Booth No. 51.

BARCO BRASS AND JOINT COMPANY.

Flexible Ball Joints. For steam, air and oil connections. Roundhouse Blower sets and blow-off sets.

Booth No. 76.

BOGARDUS COMPANY.

"Tre-Foil" Locomotive Steam Gauges. "Trident Hylo" Water Alarm for water tanks.

Booth No. 11.

CANTON CULVERT CO., THE.

Galvanized, corrugated culverts, made of NO-CO-RO metal, which is a reliable acid-resisting iron of almost 100% purity.

Booth No. 35.

CHICAGO CAR DOOR COMPANY.

The Car Door "that won't come off," unless car is wrecked. Storm, spark and thief proof.

Booth No. 3.

CHICAGO CAR HEATING COMPANY.

Newest system of heating—economical, simple and durable.

Booth No. 19.

CHICAGO STEEL TAPE COMPANY.

Surveying instruments. Common sense things for field work, such as tapes, flag poles, rods, arrows, etc.

Booth No. 50.

COFFMAN'S PERMANENT WAY.

A Permanent Roadbed, formed of concrete, stone and suitable bindings, using a steel tie.

Booth Nos. 7-8.

CRANE COMPANY.

Valves, unions, etc., to meet every demand for steam, water, gas, oil, air, creosote, zinc, Chloride or Ammonia.

Booth No. 12.

CURTAIN SUPPLY COMPANY.

The newest curtain appliances for sleeping, dining cars, coaches, etc.

Booth No. 60.

DEARBORN DRUG & CHEMICAL COMPANY.

Water treatment for prevention of foaming, pitting, scale and leaks in boilers. Made to suit actual water conditions.

Booth No. 11.

DETROIT HOIST & MACHINE COMPANY.

Pneumatic and Electric Turn-Table Tractors. Pneumatic and Electric Hoists. Chain Blocks, etc.

Booth No. 93.

ECONOMY RAIL CREEPER, THE.

A rail creeper pressed from No. 10 sheet steel and secured in place by an ordinary track spike.

Booth No. 56.

O. M. EDWARDS CO., THE.

Window Fixtures and metal trap doors for both steel and wood passenger equipment. Metallic furniture.

Booth No. 6.

FIRE-CLAY DEVELOPMENT CO., THE.

High-Grade Fire-Clay, Arches for Locomotives and Fire Brick for Oil Burners, also specially designed brick for all refractory purposes.

Booth No. 11.

FLEMING-HEBARD CO., THE.

General railway supplies and equipment.

Booth No. 48.

FROST PAINT AND MANUFACTURING CO.

"KAPAK" and Hydro-Carbon Paints for locomotives and steel cars. SNELLING BOILER COMPOUNDS for scale, corosion, etc., in Locomotive Boilers.

Booth No. 93.

FOREST CITY PAINT & VARNISH COMPANY.

Manufacturers of "NEV-A-RUST" paint, as well as other brands of durable paints.

Booth No. 33.

GOLD CAR HEATING AND LIGHTING CO.

Vapor and Combination Pressure and Vapor system of Car Heating. Ventilators for passenger and refrigerator cars. Acetylene System of car lighting.

Booth No. 104.

HEATH AND MILLIGAN COMPANY.

One of the oldest firms in this line; makers of a long line of paint for every conceivable railroad need.

Booth Nos. 21-22.

INTERNAT'L INTER-LOCKING RAIL JOINT COMPANY.

A flexible bond between rails without plate, bolt or nut.

Booth No. 4.

JOLIET RAILWAY SUPPLY COMPANY.

Displaying the Huntoon Safety High Speed brake beam for P. C. Air Brake Equipment. Perry Self-Centering Anti-Friction Roller Side Bearings, etc.

Booth Nos. 106-107.

KARPEN & BROS., S.

Quality makers and designers of artistic furniture for dining and parlor cars.

Booth No. 58.

KENNICOTT COMPANY, THE.

Water Softening Machinery. General Steel Plate Construction. Underframe, Tank Cars, Water & Oil Tanks, Riveted Pipe Track Troughs, etc.

Booth No. 73.

KINKAID BRAKE SHOE CO., THE.

A FLANGE LUBRICATOR for lubricating the flanges of engine wheels, car wheels, etc.

Booth No. 24.

KNEEDLER, COUCH & HANSEN.

Displaying the Kneedler steel reinforced concrete railroad tie. Efficient, reliable, safe and durable.

Booth No. 17.

L.-J. DEVELOPMENT COMPANY, THE.

Displaying an Automatic Connector for Steam, Air and Signal Lines, as well as electric connections.

Booth No. 26.

MACRAE'S RAILWAY & SUPPLYMEN'S MUTUAL CATALOGUE.

It affords the real short cut for the use of supplymen in bringing their products to the attention of railroad purchasing agents.

Booth No. 11.

MODOC CO., THE.

The Modoc car cleaner is a preparation for use in cleaning exterior and interior of car bodies.

Booth No. 121.

NICKEL-CHROME CHILLED CAR WHEEL COMPANY.

Nickel-Chrome Chilled Car Wheel gives 500% greater strength of flange than ordinary chilled wheel under Lobdell Flange Test.

Booth No. 31.

OGLE CONSTRUCTION COMPANY.

Steel Coaling Stations with automatic coal handling machinery.

Booth No. 92.

PUBLIC CUP VENDOR COMPANY.

Owner of Luellen Patents on Individual Drinking Cups and cup dispensing apparatus.

Booth Nos. 14-15.

PYLE-NATIONAL ELECTRIC HEADLIGHT COMPANY.

Displaying their Type "E" turbo-generating set, which evaporates less water per E. H. P., than any other turbo designed for like service.

Booth No. 10.

RAILWAY UTILITY COMPANY.

Displaying Car Heating apparatuses, Car Ventilators and Lamp Jacks, Automatic Freight Car Door Locks and Portable Electric Vacuum Car Cleaners.

Booth No. 122.

RUMSEY CAR DOOR & EQUIPMENT CO.

The door that is absolutely burglar and moisture proof.

Booth No. 71.

ST. LOUIS TRUCK AND MANUFACTURING COMPANY.

Manufacturers of the famous SELF-OILING STEEL TRUCKS.

Booth No. 11.

STERLING VARNISH CO., THE.

Reliable metal preserving paints for bridges, coal, and gondola cars.

Booth No. 57.

U. S. METALLIC PACKING COMPANY, THE.

King-Type Metallic Packing for valve stems, piston rods of locomotives, etc. Air Pump Packing. Gollmar Bell Ringer and the Leach Sanders.

Booth No. 75.

U. S. WIND ENGINE AND PUMP COMPANY, THE.

Displaying Water Columns, Locomotive Watering Devices, Pumping Machinery, Switches, Semaphores, Windmills, etc.

Booth No. 32.

VERONA TOOL WORKS.

Track Tools and Nut Locks.

Booth No. 72.

WILCOX ENGINEERING COMPANY.

Wilcox Feed Water Weigher keeps tab on the evaporation costs.

Booth No. 25.

WIRE-WOOD SEAL COMPANY, THE.

Displaying a new device for sealing cars. Un-interchangeable easily stocked, quickly applied, scientifically safe and economical.

Trade Publications.

American Engineer......	Booth	No.	18
Railway Age Gazette...	"	"	18
Railway and Engineering Review	"	"	105
Railroad Herald	"	"	79
Signal Engineer	"	"	18

Booth No. 96.

Augus Sinclair Company, Publishers

RAILWAY AND LOCOMOTIVE ENGINEERING.

(Official Organ of the Exhibit.)